DEPARTMENT OF THE ARMY TECHNICAL MANUAL

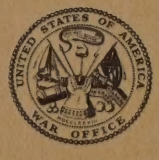
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM11-2143

TO16-35TS712-5

TELEPHONE TEST SET

TS-712/TCC-11



DEPARTMENTS OF THE ARMY AND THE AIR FORCE

NOVEMBER 1953

TECHNICAL MANUAL
No. 11-2143
TECHNICAL ORDER
No. 16-35TS712-5

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *23 November 1953*

TELEPHONE TEST SET TS-712/TCC-11

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WARNING

HIGH VOLTAGE

is present in this equipment
when it is connected
to Telephone Repeater
AN/TCC–11.

Do not work inside Telephone Test Set TS–712/TCC–11 unless it is disconnected from Telephone Repeater AN/TCC–11.

ARTIFICIAL RESPIRATION

GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward;* the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders.

Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now, repeat the cycle.

5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

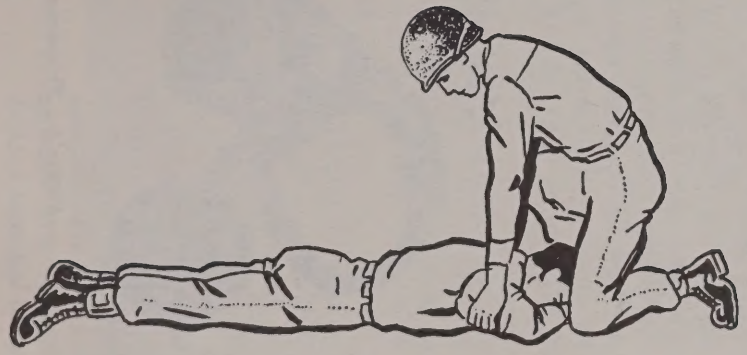
6. *Changing Position or Operator.*

(*a*) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

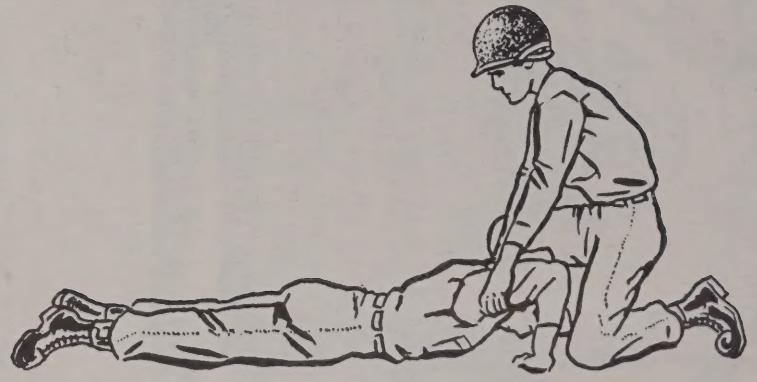
(*b*) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.

A Position of operator and victim

B Compression phase



C Expansion phase (arm lift)



D Expansion phase (arm release)

TM AR-4

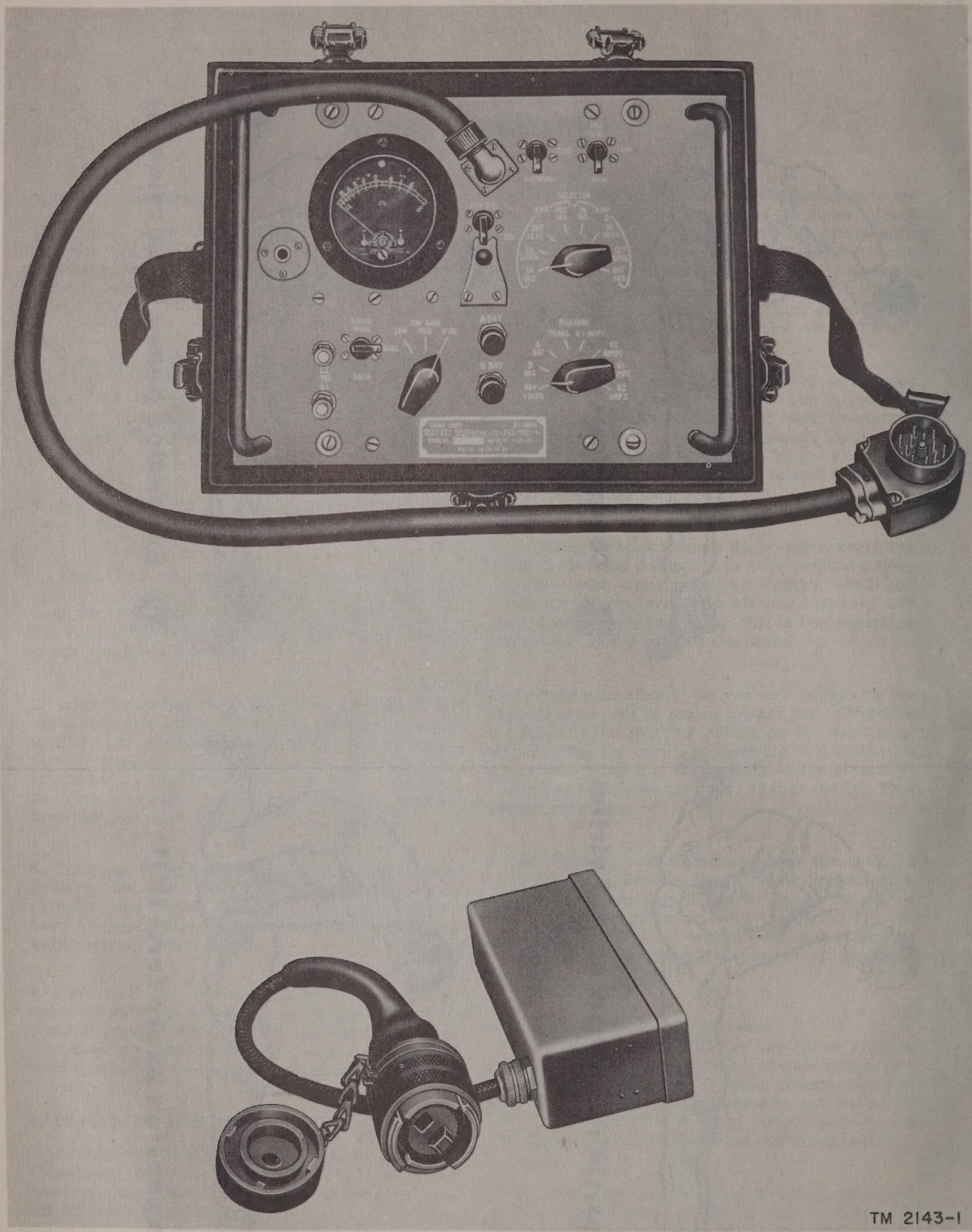


Figure 1. Telephone Test Set TS–712/TCC–11.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual is for personnel to whom this equipment is issued. This equipment is used only for testing and maintaining Telephone Repeater AN/TCC–11. The manual deals mainly with Telephone Test Set TS–712/TCC–11 but also includes all necessary information for testing Telephone Repeater AN/TCC–11 at an unattended location in the carrier system. No other manual is required at the unattended location.

b. In addition to the instructions, two appendixes are included. Appendix I contains a list of references. Appendix II contains an identification table of parts.

Note. Throughout this technical manual, whenever the term TS–712 test set is used, it will refer to Telephone Test Set TS–712/TCC–11; similarly, reference to artificial cable Z1 will mean electrical dummy load Z1 (a subassembly of the TS–712 test set); reference to AN/TCC–7 will mean Telephone Terminal AN/TCC–7; reference to AN/TCC–8 will mean Telephone Repeater AN/TCC–8; and reference to AN/TCC–11 will mean Telephone Repeater AN/TCC–11. Basic nomenclature followed by ( ) refers to all models of the equipment.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), Navy Shipping Guide, Article 1850–4, and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 11).

e. DA Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 12).

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Purpose.

(1) Telephone Test Set TS–712/TCC–11 (fig. 1) is a battery-operated, portable test set. It contains facilities for making tests at Telephone Repeater AN/TCC–11, and also, for ringing and establishing voice communication to attended points when used with Telephone EE–8–( ) (fig. 5).

(2) An artificial cable (fig. 4), which is self-contained, is a part of Telephone Test Set TS–712/TCC–11. The purpose of the artificial cable is to simulate the transmission losses of 5¾ miles of spiral-four cable and is used in testing Telephone Repeater AN/TCC–11.

b. Use.

(1) Telephone Test Set TS–712/TCC–11 is used at the AN/TCC–11 repeater to check the transmission levels of 68 kilocycles (kc) and 1 kc, the d-c operating voltage, and the emission characteristics of the amplifier tubes. To facilitate performance of these tests, the TS–712 test set is used with Telephone EE–8–( ) to communicate from a remote AN/TCC–11 repeater over the order wire to an AN/TCC–7 terminal or to an AN/TCC–8 repeater.

(2) The artificial cable of the TS–712 test set is used for testing the AN/TCC–11 repeater by looping the transmission paths of the AN/TCC–11 through a network which simulates the transmission losses of 5¾ miles of spiral-four cable.

4. System Application

Telephone Test Set TS–712/TCC–11 is used at attended or unattended locations in the 12-channel carrier telephone system to test Telephone Repeater AN/TCC–11. At attended locations, tests are made to determine the electrical condition of the AN/TCC–11 repeater, prior to installation in the system, or to diagnose trouble in a defective AN/TCC–11 repeater which has been removed from service. At unattended locations, tests are made during or after installation of AN/TCC–11 repeaters in the system. After completion of the tests, the TS–712 test set is removed since it is not an operating component of the system.

a. Telephone EE–8–( ), a part of the TS–712 test set, is used at unattended locations to establish contact with attended locations during testing.

b. The artificial cable, also a part of the TS–712 test set, normally is used at attended locations. However, the artificial cable also may be used at unattended locations when conditions demand that the tests be performed in the absence of cable on the far side of the AN/TCC–11 repeater with respect to the attended location supplying power to the AN/TCC–11 repeater under test.

5. Technical Characteristics of Telephone Test Set TS–712/TCC–11

Tube types and functions	Two 1U5 (V1 and V2), first voltage amplifier, and second voltage amplifier and rectifier.
Transistor (amplifying crystal unit) type and function.	One 2N21 (Q1), 1,600-cps oscillator.
Operating temperature range	−65° F to 150° F.
Batteries required:	
A battery (BT 1)	1.5 v.
B battery (BT 2)	90 v.
Measurements, AN/TCC–11 repeater:	
Transmission frequencies	1 to 1.6 kc and 68 kc.
D-c voltage	150 v.
Ringing signal	1,600 cps.
Meter:	
Sensitivity	100 ua full scale deflection.
Type current	dc.
Type scale	db calibrations.
Scale markings	−12 db to +8 db, and BAT.

6. Technical Characteristics of Artificial Cable

The artificial cable simulates the loss characteristics of the spiral-four cable in the frequency range of 12 to 68 kc. The loss it represents is equivalent to 5¾ miles of spiral-four cable.

7. Packaging Data

a. When packaged for export shipment, Telephone Test Set TS–712/TCC–11 is placed in a moisture-vaporproof container, and packed in a wooden crate. A cutaway view of the TS–712 test set, packed for export, is shown in figure 6. The export crate is 15 inches wide, 14 inches high, and 27 inches deep. It has a volume of 3.3 cubic feet. The packed crate weighs 72 pounds.

Note. Items may be packaged in a manner different from that shown in figure 6, depending upon the supply channel.

b. The following chart lists the contents of the crate. See the packing list attached to the crate for exact contents.

Crate dimensions (in.)	Contents
14 x 15 x 27	1 Telephone Test Set TS–712/TCC–11. 1 Artificial cable. 1 Telephone EE–8–( ).

8. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu. ft.)	Unit weight (lb.)
Telephone Test Set TS–712/TCC–11	1	7½	9⅞	13⅜	0. 573	19
Artificial cable	1	3½	2	7½	. 03	5
Telephone EE–8–( )	1	9 9/16 (aprx)	3½ (aprx)	7 11/16 (aprx)	. 149 (aprx)	9¾ (aprx)

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

9. Description of Telephone Test Set TS–712/TCC–11

(figs. 2 and 3)

Test Set TS–712/TCC–11 is a portable test equipment which is used for testing the transmission frequencies, direct-current (d-c) operating voltages, and the tube emission of the AN/TCC–11 repeater.

a. Telephone Test SET TS–712/TCC–11 is inclosed in an olive drab, metal carrying case (fig. 2). A removable cover is held in place by spring snap catches. A carrying strap is provided. The TS–712 test set is set into the carrying case so that the panel and operating controls are exposed when the cover of the case is removed. The top panel and the controls are mounted on gaskets which allow the TS–712 test set to be used in a driving rain, with the cover removed, without damage.

Figure 2. Telephone Test Set TS–712/TCC–11 in carrying case, cover closed.

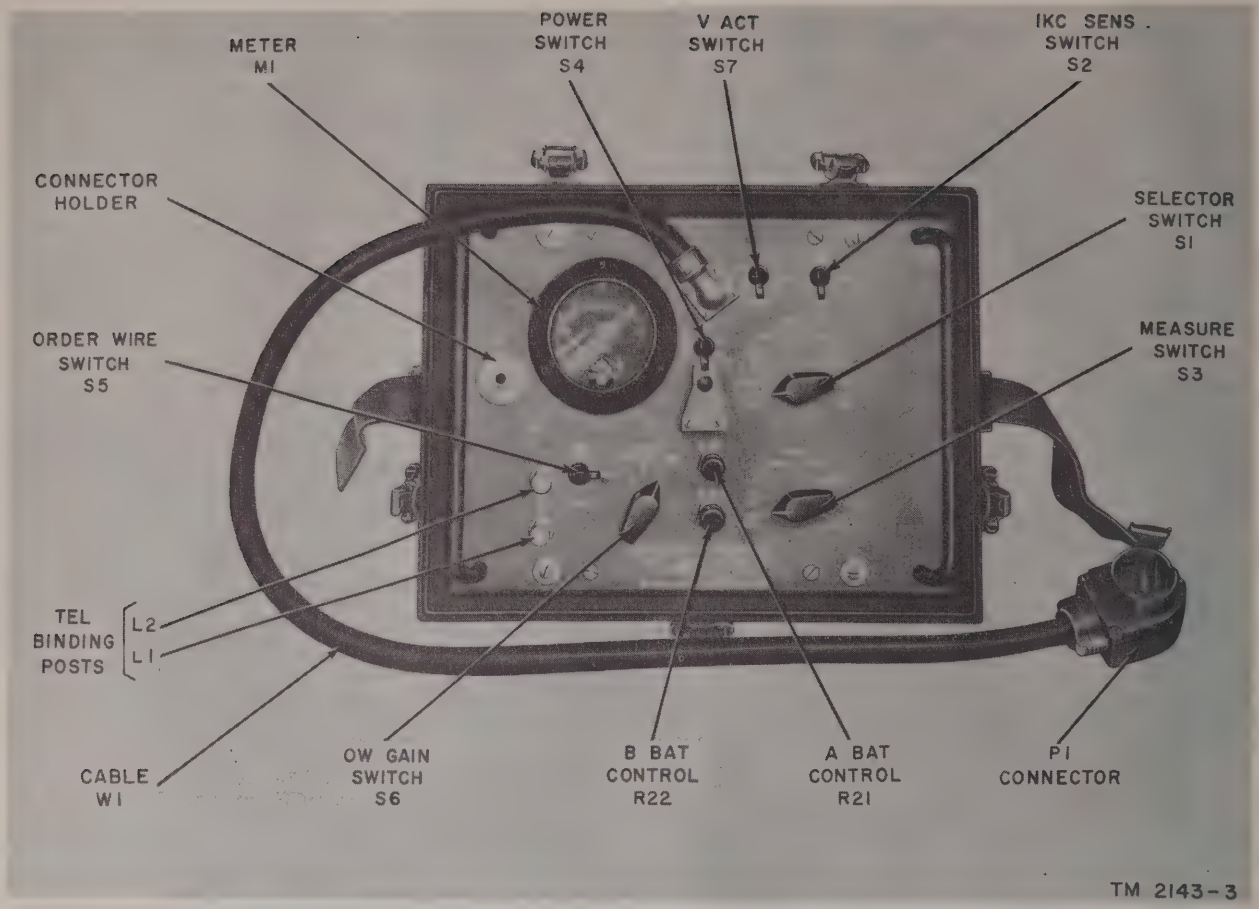


Figure 3. Telephone Test Set TS–712/TCC–11, top-panel view.

b. The top panel of the TS–712 test set mounts the following items: a meter, calibrated in decibels (db), for indicating test measurements; two telephone (TEL) binding posts L1 and L2 for connection to Telephone EE–8–( ); seven switches; and two control knobs.

(1) The switches consist of a rotary SELECTOR switch for selecting transmission test points in the repeater, a rotary MEASURE switch for selecting alternating-current (a-c) or d-c measurements, a V ACT vacuum tube activity switch for testing the cathode emission of tubes in the AN/TCC–11 repeater, a 1KC SENS switch to select the TS–712 test set sensitivity level to 1-kc transmission while that frequency is being tested, a POWER switch, an ORDER WIRE switch, and an OW GAIN switch.

(2) The controls mounted on the top panel are an A BAT adjustment control and a B BAT adjustment control. Connection is made to the AN/TCC–11 repeater through the cable attached to the top panel of the TS–712 test set.

c. The GAIN calibration control is located on top of the bottom chassis (fig. 32). This control is adjusted when the TS–712 test set is calibrated at Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8.

d. The A battery and the B battery for the transmission-test amplifier circuit are fastened to the underside of the top panel with two brackets. The lower part of the chassis is hinged and can be opened out to expose the back side of the top panel (fig. 34).

10. Description of Artificial Cable

(fig. 4)

The artificial cable is a part of Telephone Test Set TS–712/TCC–11. The unit consists of a short length of spiral-four cable, a cable connector, and a single metal box containing circuits the loss characteristic of which is equivalent to 5¾ miles of spiral-four cable.

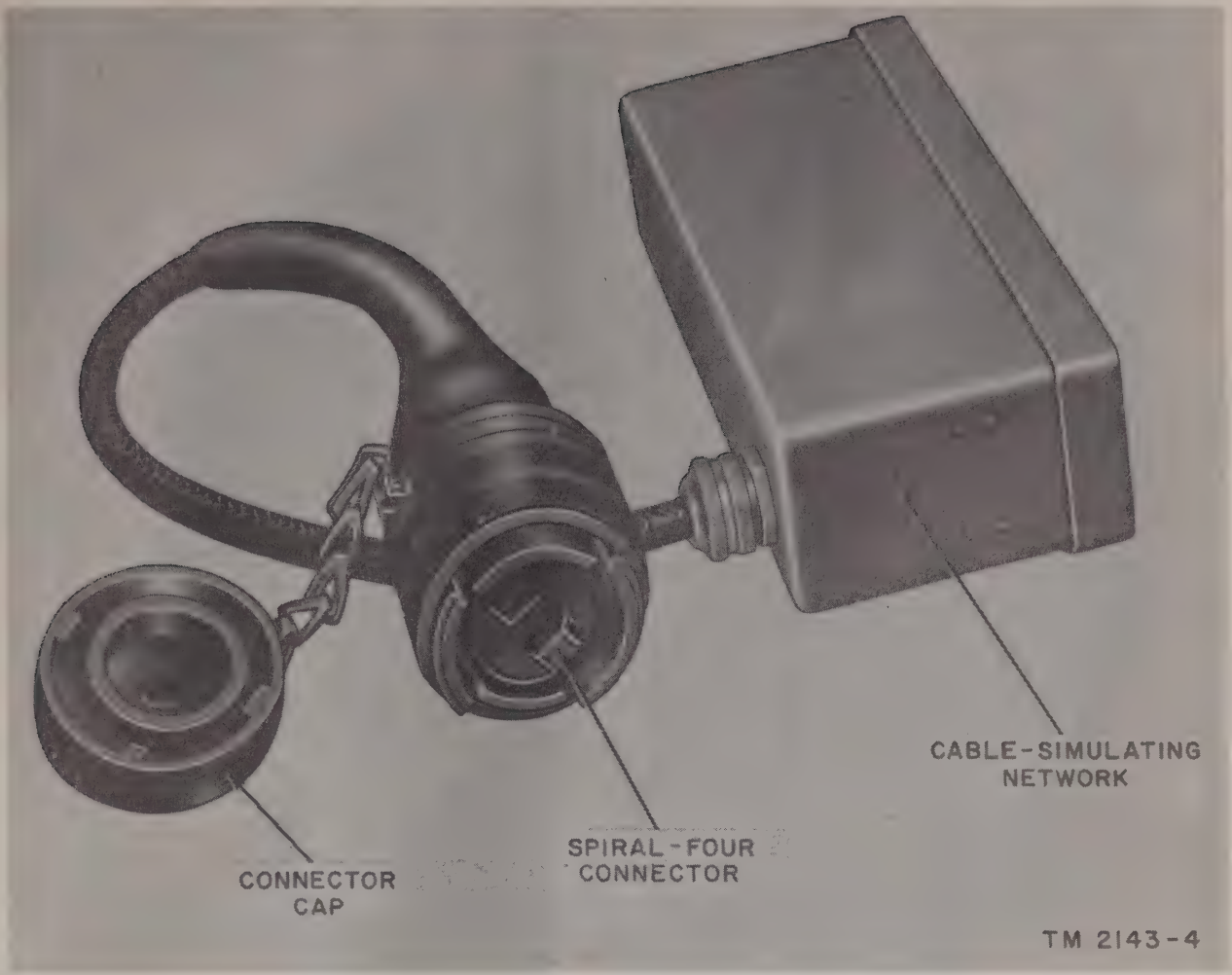


Figure 4. Artificial cable (part of Telephone Test Set TS–712/TCC–11), showing spiral-four connector.

11. Running Spares

Running spares for Telephone Repeater AN/TCC–11 and Telephone Test Set TS–712/TCC–11 are stored in the TS–712 test set. In the cover, 6 blue and 12 white spare lightning arrestors for Telephone Repeater AN/TCC–11 are stored. One spare amplifying tube (1U5) for the TS–712 test set is located on the top, rear of the chassis (fig. 35). One spare transistor for the TS–712 test set is located on the bottom, left rear of the chassis (fig. 36).

12. Additional Equipment Required

a. The following material is *not* supplied as part of the TS–712 test set, but is required for its operation: the A battery (Battery BA–402/U) and the B battery (Battery BA–415/U).

b. Telephone EE–8–( ), packed with the TS–712 test set, is required for operation on the order-wire circuit. Telephone EE–8–( ) is described in TM 11–333.

Figure 5. Telephone EE–8–( ).

CHAPTER 2
INSTALLATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

13. Siting

Telephone Test Set TS–712/TCC–11 is used in conjunction with unattended Telephone Repeater AN/TCC–11, attended Telephone Repeater AN/TCC–8, or Telephone Terminal AN/TCC–7. The location for the use of the TS–712 test set is determined by the location of these equipments.

a. When the lineman is using the TS–712 test set at the unattended AN/TCC–11 repeater, he should position the TS–712 test set so that he can reach the top panel controls and read the top panel meter.

b. When Telephone Repeater AN/TCC–11 is tested at an attended point (Telephone Repeater AN/TCC–8 or Telephone Terminal AN/TCC–7), the artificial cable must be used.

14. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 18.

a. General. Equipment may be shipped in an export packing case, in a domestic packing case, or sometimes in its own carrying case. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements. The instructions in *b* below, apply to equipment shipped in an export packing case, and the instructions in *c* below, apply to equipment shipped in a domestic packing case. Aside from checking to make sure that the equipment is undamaged, no special unpacking and uncrating procedures are necessary for equipment shipped in its own carrying case.

Caution: Be careful in uncrating, unpacking, and handling the equipment; it becomes damaged easily. If it is damaged or exposed, a complete overhaul may be required or the equipment may be rendered useless.

b. Step-by-Step Instructions for Uncrating and Unpacking Export Shipments (fig. 6).

(1) Place the packing case in a convenient position.
(2) Cut and fold back the steel straps.
(3) Remove the nails from the crate with a nailpuller. Remove the top of the packing case. Do not attempt to pry off the sides and top; the equipment may become damaged.
(4) Remove the moistureproof barrier and any excelsior or corrugated paper that covers the equipment inside the case.
(5) Remove the equipment from its inner case and place it on the workbench or in a location convenient for making an inspection.
(6) Inspect the equipment for possible damage incurred during shipment. Check the spare lightning arrestors to determine that they are of the proper rating.
(7) Check the contents of the packing case against the master packing slip.

c. Unpacking Domestic Packing Cases. Equipment may be received in a domestic packing case. The instructions given in *b* above apply also to unpacking domestic shipments. Cut the metal bands. Open the cartons that protect the equipment; or, if heavy wrapping paper has been used, remove it carefully and take out the components. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers. They can be used again when the equipment is repacked for storage or shipment.

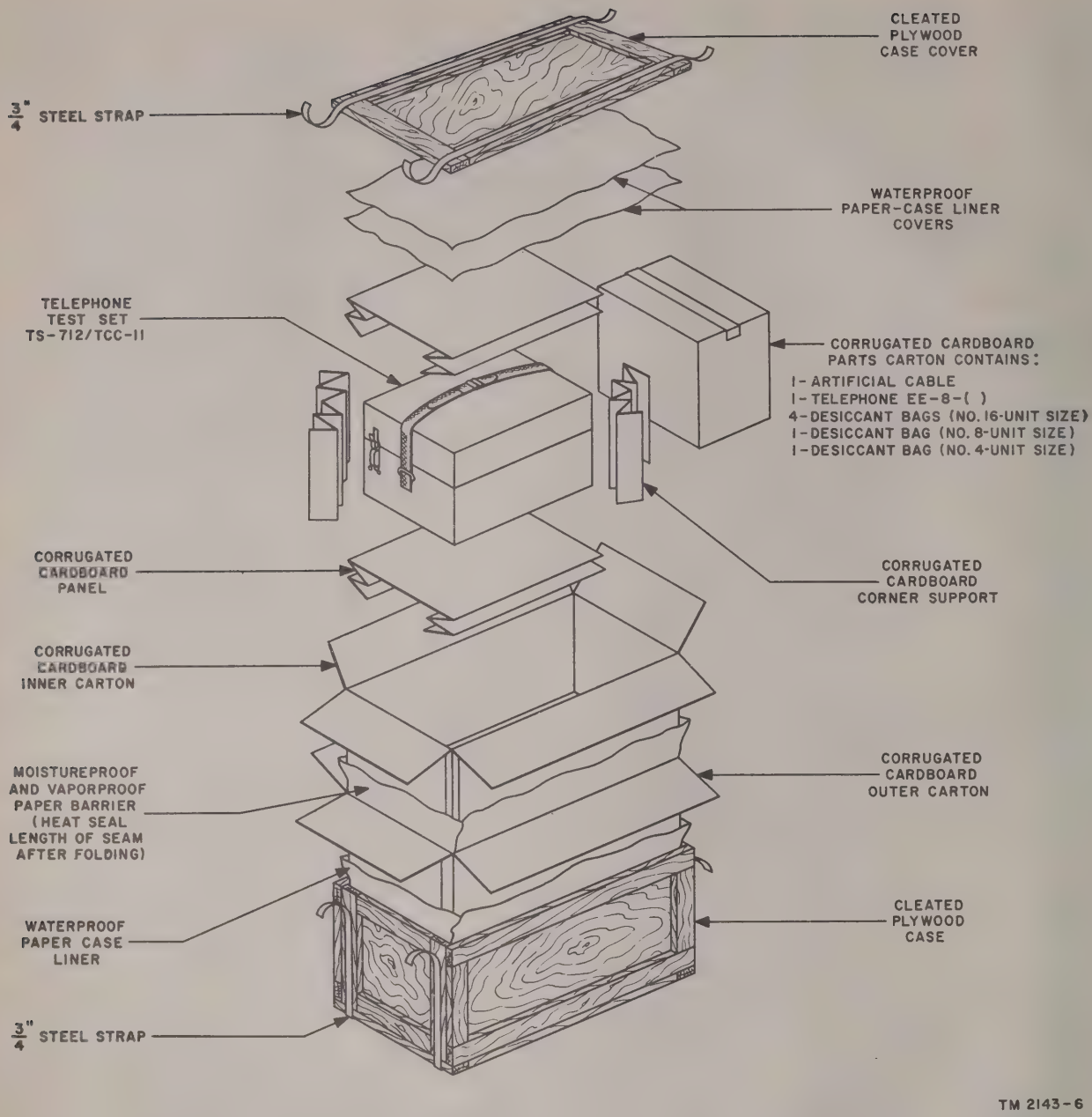

CLEATED PLYWOOD CASE COVER
3/4" STEEL STRAP
WATERPROOF PAPER-CASE LINER COVERS
TELEPHONE TEST SET TS-712/TCC-11
CORRUGATED CARDBOARD PARTS CARTON CONTAINS:
1-ARTIFICIAL CABLE
1-TELEPHONE EE-8-( )
4-DESICCANT BAGS (NO. 16-UNIT SIZE)
1-DESICCANT BAG (NO. 8-UNIT SIZE)
1-DESICCANT BAG (NO. 4-UNIT SIZE)
CORRUGATED CARDBOARD PANEL
CORRUGATED CARDBOARD CORNER SUPPORT
CORRUGATED CARDBOARD INNER CARTON
MOISTUREPROOF AND VAPORPROOF PAPER BARRIER (HEAT SEAL LENGTH OF SEAM AFTER FOLDING)
CORRUGATED CARDBOARD OUTER CARTON
WATERPROOF PAPER CASE LINER
CLEATED PLYWOOD CASE
3/4" STEEL STRAP
TM 2143-6

Figure 6. Telephone Test Set TS–712/TCC–11, packing and packaging details.

15. Installation of Test Set TS–712/TCC–11

Telephone Test Set TS–712/TCC–11 normally is stored at the location of a Telephone Terminal AN/TCC–7 or an attended Telephone Repeater AN/TCC–8, and is carried to the location of an unattended AN/TCC–11 repeater when that repeater is to be tested. Other than unpacking, the only service to be performed upon receipt of the TS–712 test set is the installation of the A battery and the B battery.

16. Installation of Batteries in the TS–712 Test Set

a. Installation of Battery BT2.

(1) Loosen the carrying strap and unfasten the snap catches on the carrying case to remove the cover from the carrying case (fig. 1).

(2) Loosen the four captive screws on the top panel and pull the chassis of the TS–712/TCC–11 test set out of the carrying case (fig. 3).

(3) Swing the battery-bracket clip to one side and remove the two screws and the large battery bracket for battery BT2 (BA–415/U) from the underside of the top panel (fig. 32).

(4) Insert connector P3 into battery BT2. Then position the battery so that connector P3 is seated in its chassis hole.

(5) Replace the battery bracket and secure it with the two screws; then swing the bracket clip back into position.

b. Installation of Battery BT1.

(1) Swing the battery-bracket clip to one side and remove the two screws and the small battery bracket for battery BT1 from the underside of the top panel.

(2) Insert connector P2 into battery BT1 (BA–402/U). Then slip the battery bracket over the battery so that connector P2 will be held securely in position.

(3) Secure the battery bracket with the two screws. Swing the bracket clip back into position.

(4) Set the chassis back into the carrying case; make sure that the top-panel gasket is seated properly, and secure it with the four corner screws on the top panel.

(5) Replace the cover on the carrying case, fasten the snap catches, and tighten the carrying strap.

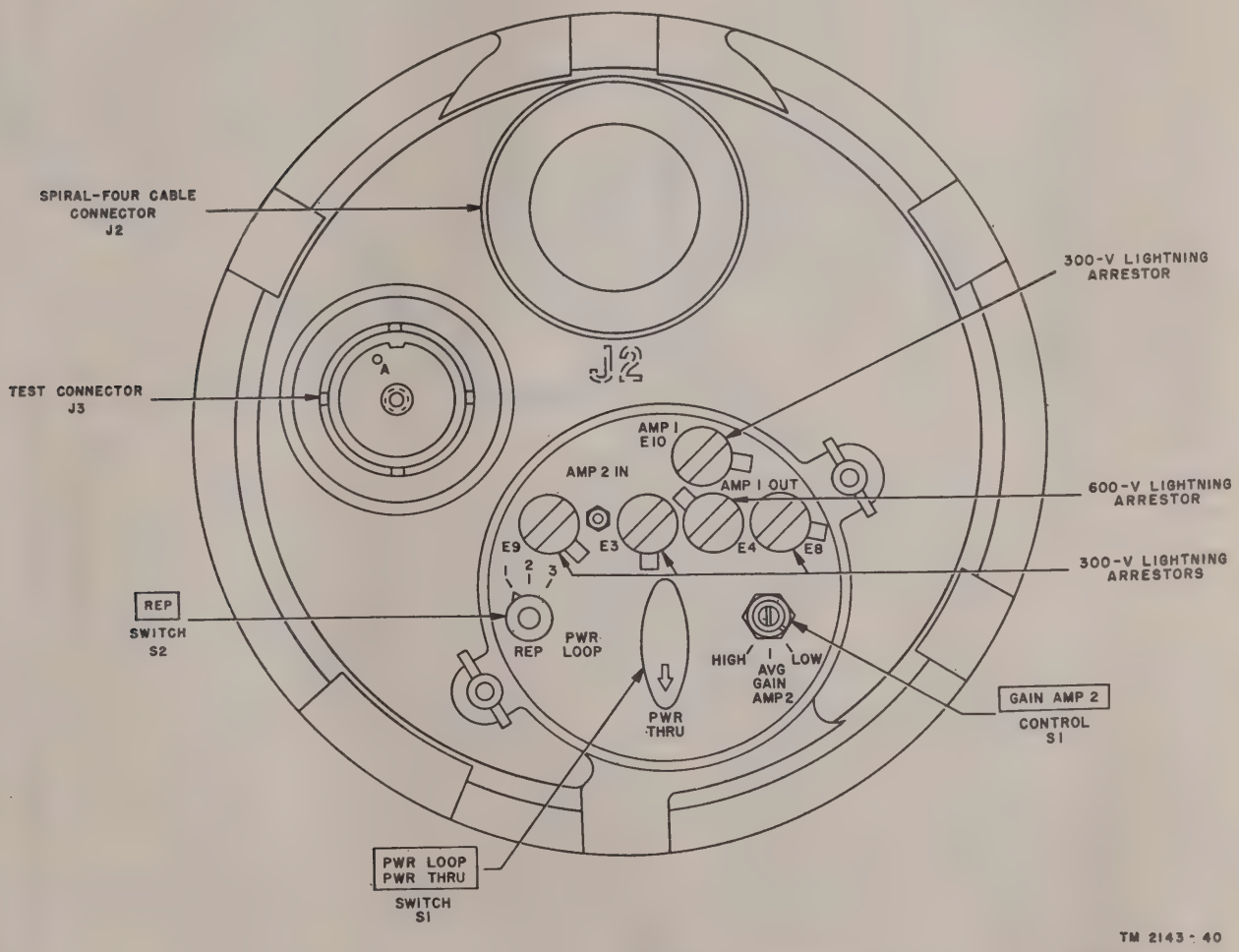


Figure 7. Telephone Repeater AN/TCC–11, J2 end panel controls.

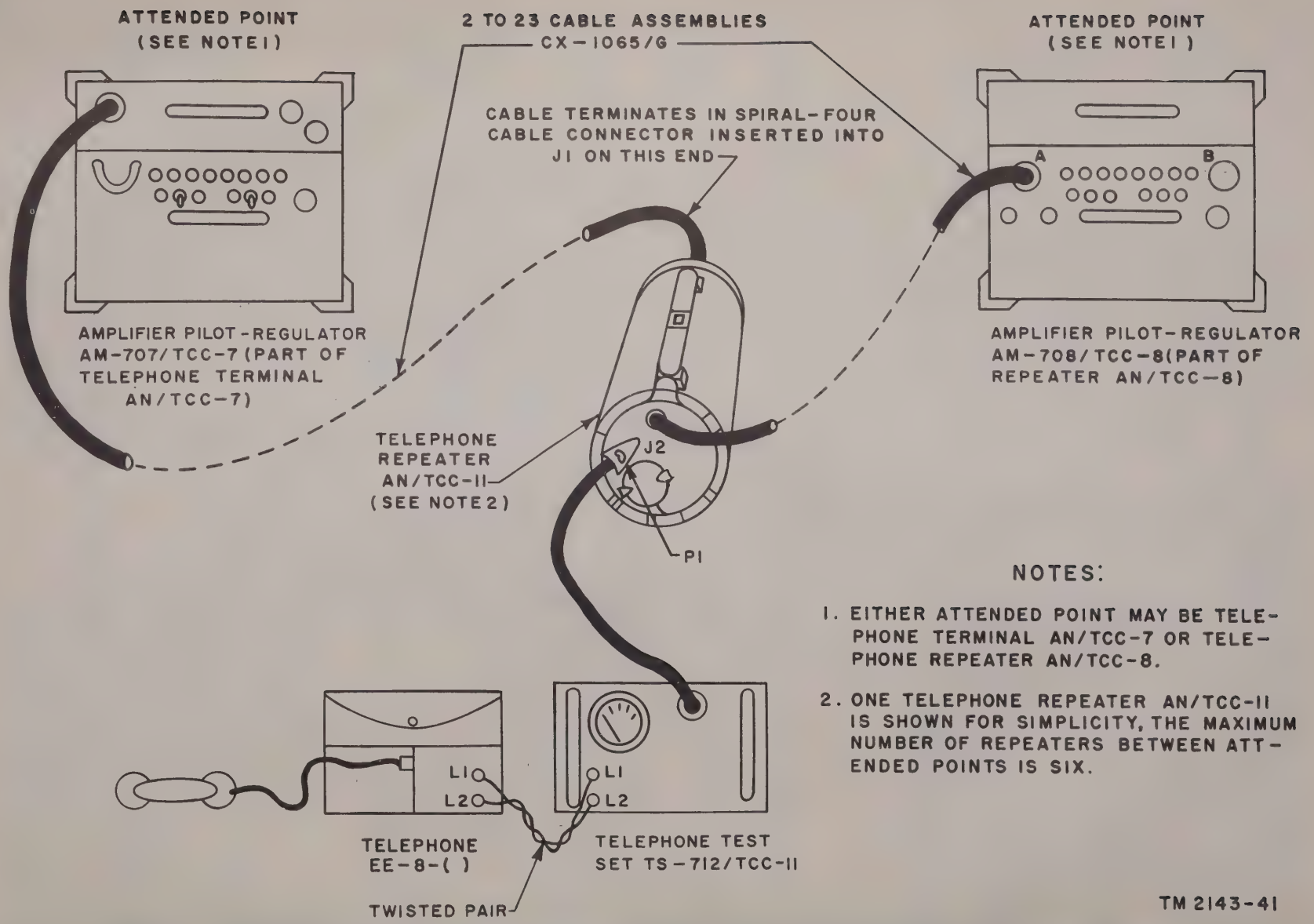

ATTENDED POINT
(SEE NOTE 1)
2 TO 23 CABLE ASSEMBLIES
CX-1065/G
ATTENDED POINT
(SEE NOTE 1)
CABLE TERMINATES IN SPIRAL-FOUR CABLE CONNECTOR INSERTED INTO J1 ON THIS END
A
B
AMPLIFIER PILOT-REGULATOR AM-707/TCC-7 (PART OF TELEPHONE TERMINAL AN/TCC-7)
AMPLIFIER PILOT-REGULATOR AM-708/TCC-8 (PART OF REPEATER AN/TCC-8)
TELEPHONE REPEATER AN/TCC-11 (SEE NOTE 2)
J2
P1
L1
L2
L1
L2
TELEPHONE EE-8-( )
TELEPHONE TEST SET TS-712/TCC-11
TWISTED PAIR
NOTES:
1. EITHER ATTENDED POINT MAY BE TELEPHONE TERMINAL AN/TCC-7 OR TELEPHONE REPEATER AN/TCC-8.
2. ONE TELEPHONE REPEATER AN/TCC-11 IS SHOWN FOR SIMPLICITY, THE MAXIMUM NUMBER OF REPEATERS BETWEEN ATTENDED POINTS IS SIX.
TM 2143-41

Figure 8. Telephone Test Set TS-712/TCC-11 connected to Telephone Repeater AN/TCC-11 for tests at unattended locations.

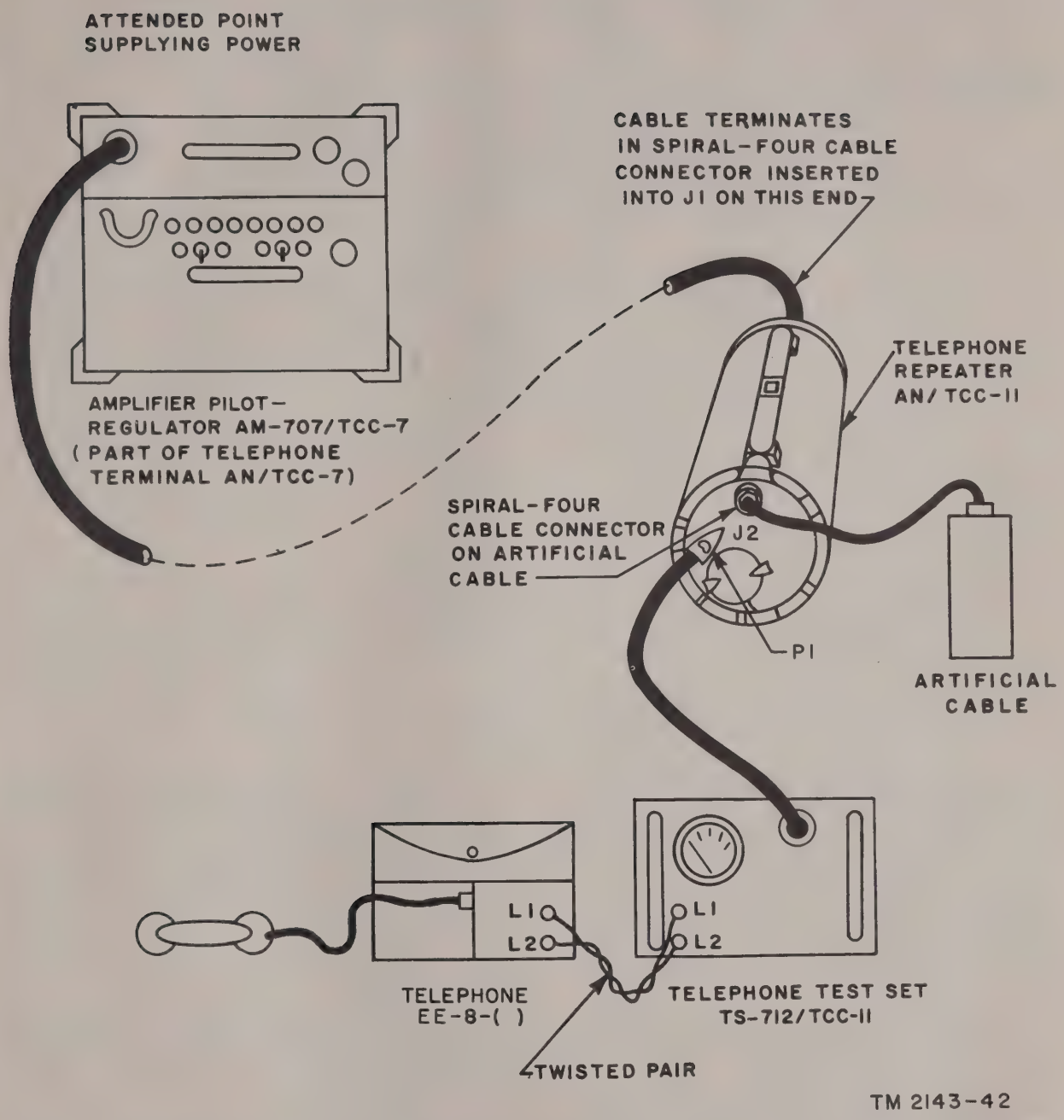


Figure 9. Telephone Test Set TS-712/TCC-11 connected to Telephone Repeater AN/TCC-11 for tests at attended locations.

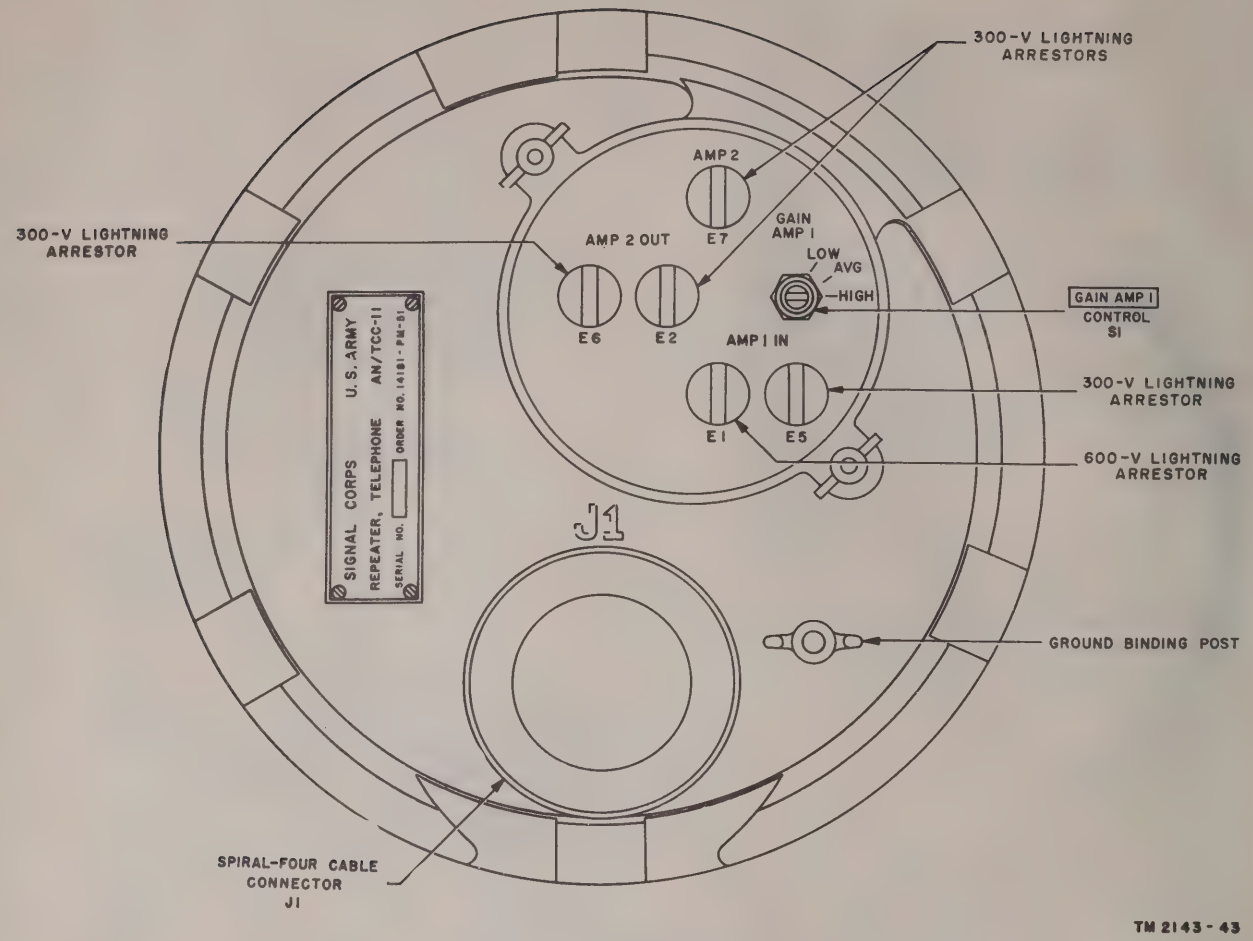


Figure 10. Telephone Repeater AN/TCC–11, J1 end panel controls.

17. Connections for Use of TS–712 Test Set

The TS–712 test set may be used at attended and at unattended locations for the purpose of checking AN/TCC–11 repeaters.

a. To connect the TS–712 test set for testing the AN/TCC–11 repeater at an attended point, proceed as follows:

(1) Remove the protective cover from TEST connector J3 on the J2 end of the AN/TCC–11 repeater (fig. 7).

(2) Connect cable connector P1 of the TS–712 test set to TEST connector J3 of the AN/TCC–11 repeater (fig. 9).

(3) Connect wires from binding posts L1 and L2 of the TS–712 test set to binding posts L1 and L2 on Telephone EE–8–( ).

(4) Connect artificial cable Z1 to connector J2 of the AN/TCC–11 repeater.

(5) Connect connector J1 of the AN/TCC–11 repeater to the spiral-four connector of the attended point (located on the junction panel of the AN/TCC–7 terminal or the repeater panel of the AN/TCC–8 repeater).

b. To connect the TS–712 test set for testing the AN/TCC–11 repeater at an unattended point proceed as follows:

(1) Repeat the instructions in *a*(1) through (3) above.

(2) Connect connectors J1 and J2 on the AN/TCC–11 repeater to the spiral-four cable as required when the AN/TCC–11 repeater is operating normally (figs. 7, 8, 10).

18. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 14 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the change in this manual, preferably on the schematic diagram (fig. 43) and the wiring diagram (fig. 44).

c. Check the operating controls for ease of operation.

d. Install the batteries as described in paragraph 16.

Section II. CONTROLS AND INSTRUMENTS

Note. This section describes, locates, and illustrates the various controls provided for the proper operation of the equipment and furnishes the operator with sufficient information pertaining to these controls.

19. General

Haphazard operation or improper setting of the controls on the TS–712 test set can cause improper operation or misleading test indications. For this reason, it is important to know the function of every control switch or knob on the TS–712 test set. The actual operation of the equipment is discussed in chapter 3.

20. Telephone Test Set TS–712/TCC–11, Controls and Their Uses

(fig. 3)

The following table lists the controls on the TS–712 test set and describes their function. All the controls are mounted on the top panel, except GAIN control R10 which is located on the top of the bottom chassis (fig. 32).

Controls	Function
POWER switch (S4)	Two-position lever switch. In the ON position, connects the batteries to the transmission test circuit, and connects the meter to the transmission test circuit selected by MEASURE switch S3. Replacing the cover on the TS–712 test set, or manually depressing the plate at the switch, releases the switch lever and the switch returns to the off position. In the off position, the switch disconnects the battery from the transmission test circuit and connects the meter terminals to ground for protection of the meter.
V ACT switch (S7)	Two-position nonlocking switch: used in test of emission (vacuum tube activity) of tubes V1 and V2 of line amplifiers AR1 and AR2 in the AN/TCC–11 repeater:
V ACT switch (S7)—Continued	In TEST position, shunts a resistor across the d-c circuits of the AN/TCC–11 repeater to reduce the filament voltage. The effect on emission of the tube selected by MEASURE switch S3 is indicated on TS–712 test set meter.
	In NORMAL position, removes shunt from across the d-c circuits of the AN/TCC–11 repeater.
PANEL meter (M1)	D-c microammeter which connects to various test measurement circuits through MEASURE switch S3. Meter is calibrated in db. BAT marking on scale is a reference point for d-c voltage measurements.
MEASURE switch (S3).	Eight-position rotary switch to connect meter M1 to various test circuits:
	In REP VOLTS position, connects meter to read d-c voltage across AN/TCC–11 repeater d-c power circuits.
	In B BAT position, connects meter to read plate and screen supply voltage of transmission test amplifier tubes.
	In A BAT position, connects meter to indicate filament voltage of transmission test amplifier tubes.
	In TRANS position, connects meter to measure output of transmission test amplifier. Used with the eight positions of SELECTOR switch S1.

20. Telephone Test Set TS–712/TCC–11—Continued

Controls	Function
MEASURE switch (S3)—Continued	In V1 AMP 1 position, connects meter to indicate space current of tube V1 in line amplifier AR1 of the AN/TCC–11 repeater. In V2 AMP 1 position, connects meter to indicate space current of tube V2 in line amplifier AR1 of the AN/TCC–11 repeater. In V1 AMP 2 position, connects meter to read space current of tube V1 in line amplifier AR2 of the AN/TCC–11 repeater. In V2 AMP 2 position, connects meter to indicate space current of tube V2 in line amplifier AR2 of the AN/TCC–11 repeater.
A BAT control (R21)	Variable control to adjust the filament voltage of the TS–712 test set amplifier tubes when MEASURE switch S3 is in the A BAT position.
B BAT control (R22)	Variable control to adjust plate and screen voltages of TS–712 test set amplifier tubes when MEASURE switch S3 is in the B BAT position.
SELECTOR switch (S1)	Eight-position rotary switch to connect transmission test circuit to various transmission test points in AN/TCC–11 repeater: In AMP 1 IN 1 KC position, connects transmission test circuit, arranged for 1-kc test frequency or 1,600-cycle ringing signal measurement, to input of line amplifier AR1 of AN/TCC–11 repeater. In AMP 1 IN 68 KC position, connects transmission test circuit, arranged for 68-kc measurement, to input of line amplifier AR1 of AN/TCC–11 repeater. In AMP 1 OUT 68 KC position, connects transmission test circuit, arranged for 68-kc measurement, to output of line amplifier AR1 of AN/TCC–11 repeater. In AMP 1 OUT 1 KC position, connects transmission test circuit, arranged for 1-kc test frequency or 1,600-cycle ringing signal measurement, to output of line amplifier AR1 of AN/TCC–11 repeater. In AMP 2 IN 1 KC position, connects transmission test circuit, arranged for 1-kc test frequency or 1,600-cycle ringing signal measurement, to input of line amplifier AR2 of AN/TCC–11 repeater. In AMP 2 IN 68 KC position, connects transmission test circuit, arranged for 68-kc measurement, to input of line amplifier AR2 of AN/TCC–11 repeater. In AMP 2 OUT 68 KC position, connects transmission test circuit, arranged for 68-kc measurement, to output of line amplifier AR2 of AN/TCC–11 repeater. In AMP 2 OUT 1 KC position, connects transmission test circuit, arranged for 1-kc test frequency or 1,600-cycle ringing signal measurement, to output of line amplifier AR2 of AN/TCC–11 repeater.
1 KC SENS switch (S2).	Two-position lever switch: In HIGH position (normal, locking), connects the full signal at transmission test points in AN/TCC–11 repeater to the transmission test circuit when SELECTOR switch is in any 1KC position.

20. Telephone Test Set TS–712/TCC–11—Continued

Controls	Function
1 KC SENS switch (S2)—Continued	In LOW position (nonlocking), connects a 20 db loss pad into the transmission test circuit when the SELECTOR switch is in any 1KC position.
OW GAIN switch (S6)	Three-position rotary switch to vary gain of the order-wire circuit and prevent *singing*. In LOW position, inserts high-loss pads when TS–712 test set bridges the order-wire circuit at AN/TCC–11 repeater. Used when two repeaters removed from the far end of power-supply loop (nearest the power source) are being bridged (par. 21). In MED position, inserts medium-loss pads when the TS–712 test set bridges the order-wire circuit at AN/TCC–11 repeater. Used when repeater being bridged is one repeater removed from the far end in the power-supply loop (par. 21). In HIGH position, inserts low-loss pads when the TS–712 test set bridges the order-wire circuit at AN/TCC–11 repeater. Used when repeater being bridged is at the far end in power-supply loop (par. 21).
TEL binding posts (L1 and L2).	Binding posts for connecting Telephone EE–8–( ) to order-wire circuit.
ORDER WIRE switch (S5).	Two-position lever switch: In RING position, connects the output of the hand generator in Telephone EE–8–( ) to a transistor-oscillator circuit, and connects the 1,600-cycles per second (cps) output of the oscillator to the order-wire circuit. In TALK position, connects listening and talking circuits of Telephone EE–8–( ) to order-wire circuit in the AN/TCC–11 repeater.
GAIN control (R10)	Variable screwdriver control adjusts the gain of the transmission test amplifier circuit. The GAIN control must be adjusted when the TS–712 test set is calibrated at Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8 (par. 47).

CHAPTER 3
OPERATING INSTRUCTIONS

Section I. OPERATION UNDER USUAL CONDITIONS

21. Initial Adjustments and Starting Procedure

The operation of the TS–712 test set for making measurements on the AN/TCC–11 repeater is the same whether the AN/TCC–11 repeater is located at an attended or at an unattended point. To operate the TS–712 test set at an unattended point, make connections as outlined in paragraph 17*b*. To operate the TS–712 test set at an attended point make connections as outlined in paragraph 17*a*. To prepare the TS–712 test set for operation, release the catches on the carrying case and remove the cover. Make the tests and adjustments as described in paragraphs 46, 47, and 48.

a. Test Measurements. To prepare Telephone Test Set TS–712/TCC–11 for test measurements, follow the procedures outlined in paragraph 23. To prepare Telephone Test Set TS–712/TCC–11 for order-wire communication, proceed as follows:

b. Order-Wire Communication.

(1) Connect Telephone Test Set TS–712/TCC–11 to Telephone Repeater AN/TCC–11 as described in paragraph 17.

(2) If the position of the AN/TCC–11 repeater in the power loop (the AN/TCC–11 repeaters and cable sections which receive power from an attended point) is known, operate the OW GAIN switch on the TS–712 test set as follows:

(*a*) If the AN/TCC–11 repeater is at the far end of the power loop (most distant from the attended point from which power is supplied), operate the OW GAIN switch to HIGH.

(*b*) If the AN/TCC–11 repeater is one repeater removed from the far end of the power loop, operate the OW GAIN switch to MED.

(*c*) If the AN/TCC–11 repeater is two repeaters removed from the far end of the power loop, operate the OW GAIN switch to the LOW position.

(3) If the position of the AN/TCC–11 repeater in the power loop is not known, start with the OW GAIN switch at LOW. Proceed to ring and talk (par. 22). If unable to ring an attended point, or if communication has been established but the speech signals are weak, operate the OW GAIN switch to MED and HIGH successively until a position is found which gives satisfactory communication. Under some conditions the circuit may *sing* if an incorrect position of the OW GAIN switch is used. The *singing* will be heard as a tone in the receiver of the telephone handset when the ORDER WIRE switch is in the TALK position. If this occurs, operate the OW GAIN switch to the next counterclockwise position.

22. Order-Wire Communication with TS–712 Test Set

To communicate over the order-wire circuit, prepare the equipment in accordance with instructions in paragraph 21*b* and proceed as follows:

a. Ringing.

Caution: Before signaling on the order-wire circuit, make sure that the circuit is not in use by listening to the receiver of Telephone EE–8–( ). If the circuit is in use, interrupt the conversation at a convenient time and either ask permission to signal, or request an attendant to signal the desired point.

(1) Operate the ORDER WIRE switch to RING.

(2) Turn the crank of Telephone EE–8–( ) rapidly for several seconds. For suggested ringing codes, see TM 11–2150.

b. Talking and Listening. Operate the ORDER WIRE lever switch to TALK. Talking and listening is now possible through the handset of Telephone EE–8–( ).

23. TS–712 Test Set Measurements, Preliminary Adjustments

Before using the TS–712 test set for any desired test measurements, check and adjust the A- and B-battery supplies for normal voltage outputs as detailed in *a* and *b* below.

a. TS–712 Test Set A-Battery Voltage Test.

(1) Operate the MEASURE switch to the A BAT position.

(2) Operate the POWER switch to the ON position.

(3) The meter pointer should deflect to the BAT scale marking. If the pointer is off this marking, adjust the A BAT control on the top panel until the meter indication is correct. If adjustment is impossible, replace battery BT1 and readjust the A BAT control (par. 16).

b. TS–712 Test Set B-Battery Voltage Test.

(1) Operate the MEASURE switch to the B BAT position.

(2) Operate the POWER switch to ON.

(3) The meter pointer should deflect to the BAT scale marking. If the pointer is off this marking, adjust the B BAT control on the top panel until the meter indication is correct. If adjustment is impossible, replace battery BT2 and readjust the B BAT control (par. 16).

24. AN/TCC–11 Repeater D-c Power Circuit Test (REP VOLTS)

To check the voltage in the power circuit of the AN/TCC–11 repeaters, check the batteries of the TS–712 test set as described in paragraph 23. Connect the TS–712 test set to the AN/TCC–11 repeater as described in paragraph 17, and proceed as follows:

a. Operate the MEASURE switch to the REP VOLTS position.

b. Operate the POWER switch to the ON position.

c. The normal meter reading should be within ±1 db of the BAT position of the scale.

25. AN/TCC–11 Repeater Transmission Test (fig. 9)

To check transmission through the AN/TCC–11 with the TS–712 test set, proceed as follows:

a. Connect the TS–712 test set and Telephone EE–8–( ) to the AN/TCC–11 repeater as described in paragraph 17.

b. Turn the POWER switch to ON.

c. Check the batteries of the TS–712 test set as described in paragraph 23.

d. Operate the MEASURE switch to the TRANS position.

e. Operate the SELECTOR switch to the position marking the desired test point in the AN/TCC–11 repeater.

f. The normal meter reading should be 0 db for all 68-kc measurements. The normal meter readings should be as listed in the following table for all 1-kc or 1,600-cycle measurements. Before attempting to take 1-kc or 1,600-cycle readings on the TS–712 test set, arrange to have the 1–kc or the 1,600-cycle test frequency sent over the order wire from the attended point.

(1) Contact the attended point by signaling over the order-wire circuit (par. 22).

(2) For 1 kc ask the attended point attendant to operate the SEND OW switch to ON, on the attended ORDER WIRE PANEL.

(3) For a 1,600-cycle tone, ask the attended point attendant to operate the ORDER WIRE switch to RING on the attended ORDER WIRE PANEL.

Number of repeaters in power loop fed by attended point from which test tone is received	Adjustment of TS–712 test set and meter reading											
	First AN/TCC–11 (nearest sending point)				Second AN/TCC–11				Third AN/TCC–11			
	Test set switches		Meter reading		Test set switches		Meter reading		Test set switches		Meter reading	
	OW GAIN	1 KC SENS	AMP IN	AMP OUT	OW GAIN	1 KC SENS	AMP IN	AMP OUT	OW GAIN	1 KC SENS	AMP IN	AMP OUT
0	High	High	−4.5	−3.0	High	High	−13.5	−12.0				
1	High	High	+5.0	+6.5	High	High	−4.0	−2.5	High	High	−13.0	−11.5
2	Med	Low	−7.5	−5.0	High	High	+4.0	+5.5	High	High	−5.0	−3.5
3	Low	Low	+1.5	+5.5	Med	Low	−6.5	−4.0	High	High	+5.0	+6.5

Note. The above table gives approximate readings of the 1-kc test tone. When 1,600 cps is measured, the readings should be approximately 1 db higher.

26. Vacuum-Tube Activity Test of AN/TCC–11 Repeater

Telephone Test Set TS–712/TCC–11 can be used to check the tubes in an AN/TCC–11 repeater without removing the repeater from service. The cathode emission is measured as an indication of the aging of the tube. Aged tubes with decreased emission cause distortion and unwanted modulation products and must be replaced. To make the test proceed as follows:

Caution: Obtain permission from the control terminal prior to making the vacuum-tube activity test, because the test may cause excessive distortion if the tube under test is bad.

a. Connect the TS–712 test set and the Telephone EE–8–( ) to the AN/TCC repeater as described in paragraph 17. Check the batteries of the TS–712 test set as described in paragraph 23.

b. Contact the attendant at the attended point which supplies power to the AN/TCC–11 to make certain that the 600 VOLT POWER SUPPLY voltage reads within ±.5 db of the 0-db mark on the TEST PANEL meter.

c. Operate the MEASURE switch on the TS–712 test set to the V1 AMP 1 position.

d. Note the meter reading to the nearest .5 db.

(1) If the meter reading is within the range from −2 db to ±5 db, proceed as described in *e* below.

(2) If reading is not within the −2-db to ±5-db range, replace the AN/TCC–11 repeater, and attach a tag marked with the fault, giving the tube number and the amplifier number.

e. Hold the V ACT lever switch in the TEST position for 1 minute and note the meter reading at the end of that time.

(1) If the reading is within the range −5 to +5 db, and has not changed more than 5 db from the reading obtained in *d* above, the tube under test is good. Proceed as directed in *f* below.

(2) If the reading is outside the range of −5 to +5 db, or the change in reading from that obtained in *d* above is greater than 5 db, replace the AN/TCC–11 repeater and attach a tag marked with the fault, giving the tube number and the amplifier number.

f. Release the V ACT switch and wait 1 minute before proceeding with additional tests.

g. Operate the MEASURE switch to the V2 AMP 1 position and repeat the steps described in *a* through *f* above.

h. Operate the MEASURE switch to the V1 AMP 2 position and repeat steps described in *a* through *f* above.

i. Operate the MEASURE switch to the V2 AMP 2 position and repeat steps described in *a* through *f* above.

27. Use of Artificial Cable Z1

The artificial cable (part of the TS. 712 test set) is ready for use as soon as it is coupled to spiral-four connector J2 on the AN/TCC–11 repeater. The artificial cable must be used when the AN/TCC–11 repeater is tested at either an AN/TCC–7 terminal or an AN/TCC–8 repeater. This connection is shown in figure 9. Tests made with the artificial cable connected to an AN/TCC–11 repeater are described in TM 11–2150 and TM 11–2148.

28. Stopping Procedure

(fig. 3)

a. Test Measurements.

(1) Operate the POWER switch to the off position by depressing the plate which holds the switch in the ON position.

(2) Disconnect the test cable from the AN/TCC–11 repeater and fasten connector P1 to the connector holder on the top panel by turning the wingnut on connector P1.

b. Order-Wire Communication.

(1) Disconnect the wires attached to TEL binding posts L1 and L2 and Telephone EE–8–( ).

(2) Replace the cover on the carrying case, fasten the snap catches, and tighten the carrying strap.

c. Artificial Cable. Disconnect the artificial cable from the AN/TCC–11 repeater.

Section II. OPERATION OF TS–712 TEST SET FOR TROUBLESHOOTING AN/TCC–11 REPEATER AT UNATTENDED POINT

Warning: Voltages that are dangerous to life may be present in the AN/TCC–11 repeater. Whenever a procedure exposes the tester to a high voltage, the necessary safety precautions will be indicated in the instructions.

29. General

Paragraphs 30 through 41 describe the procedures to follow when troubleshooting at the AN/TCC–11 repeater point. The AN/TCC repeater point is an unattended point in the system. *Do not follow any procedure that causes interruption of the system transmission unless permission is granted by the control terminal.*

30. Equipment Required

The following equipments are needed for testing the AN/TCC–11 repeater:

a. Telephone Test Set TS–712/TCC–11.
b. Telephone EE–8–( ).
c. Multimeter TS–297/U.
d. Spare Telephone Repeater AN/TCC–11.

31. Connection of TS–712 Test Set to AN/TCC–11 Repeater at Unattended Point (fig. 8.)

Connect the TS–712 test set and the Telephone EE–8–( ) to the AN/TCC–11 repeater as described in paragraph 17. Then check and adjust the battery supplies of the TS–712 test set as described in paragraph 23.

32. General Instructions for Testing at AN/TCC–11 Repeater Point

a. At the AN/TCC–11 repeater point, first use the order wire to call the operator at the attended point. This procedure is described in paragraph 22.

b. Remain in continuous communication with the operator at an attended point and carry out the instructions sent from that point.

c. Be sure to prevent dirt and moisture from entering the repeater through any openings from which covers are removed during the tests.

d. Replace all covers securely on the AN/TCC–11 repeater before leaving the repeater.

33. Tagging Defective Repeater

When a defective repeater is replaced, attach a tag describing trouble symptoms to help expedite troubleshooting at the attended point. The tag should indicate whether the trouble is in a power circuit or transmission circuit. If the trouble is in the power circuit, mark the tag *power circuit trouble.* If the trouble is in the transmission circuit, mark the tag *transmission circuit trouble* and give a brief description of the trouble symptoms. Examples of the type of description to use are shown in the *Symptoms* column of the troubleshooting chart (par. 37).

34. Troubleshooting by Using AN/TCC–11 Repeater Equipment Performance Checklist

a. General. The equipment performance checklist for the AN/TCC–11 (par. 36) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible and audible indications that should be perceived when each item is checked. If the indications are not normal, apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those that can be applied without turning in the equipment for repairs. The only corrective measures that can be made on Telephone Repeater AN/TCC–11 equipment, while it is connected into the system, are to change the control settings, see that the spiral-four cable connectors are seated firmly in the correct connector receptacles, and check the lightning arrestors. The lineman cannot take corrective measures beyond this without replacing Telephone Repeater AN/TCC–11 with a repeater known to be good. Refer to chapter 6, TM 11–2148, or to a paragraph in that chapter, when troubleshooting by an experienced repairman is necessary, and the equipment must be replaced. However, if the tactical situation

requires that communication be maintained, and no Telephone Repeater AN/TCC–11 replacement is immediately available, the lineman must maintain the equipment in operation as long as it is possible to do so. In extreme cases, the repeater may be taken completely out of the system and the cables from the two attended points connected together. For instructions covering emergency measures needed to maintain the system, refer to TM 11–2150.

35. Auxiliary Equipment Required for AN/TCC–11

Equipment performance checks on Telephone Repeater AN/TCC–11 require use of a Telephone Test Set TS–712/TCC–11 and Telephone EE–8–( ), or equivalent. Because of the nature of the unattended repeater and the fact that operational checks must not interrupt the normal operation of the system, the lineman must perform the preparatory steps that have not been done and assume that the starting procedures have been accomplished.

36. Equipment Performance Checklist, AN/TCC–11 Repeater

Follow the procedure outlined in the equipment performance checklist in the order given:

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Spiral-four cable connector supplying power.	Inserted in connector J1		
	2	Remaining spiral-four cable connector.	Inserted in connector J2		
	3	Controls access port covers and J3 connector cover on AN/TCC–11.	Remove		
	4	REP switch (S2) on AN/TCC–11.	Operated to position 1 on first repeater in power loop.		
			Operated to position 2 on second repeater in power loop.		
			Operated to position 3 on third repeater in power loop.		
	5	PWR LOOP-PWR THRU switch (S1) on AN/TCC–11.	Operated to PWR THRU position for repeater not at junction point of power loops.		
			Operated to PWR LOOP position for repeater at junction point of power loops.		
	6	OW GAIN control on Telephone Test Set TS–712/TCC–11.	Operated to LOW, MED, or HIGH position to agree with location of repeater from attended point (par. 22).		
	7	TS–712/TCC–11	Connect the TS–712/TCC–11 to the AN/TCC–11. Mate connector P1 of test set to connector J3 on repeater.		
	8	Telephone EE–8–( )	Connect Telephone EE–8–( ) to the TS–712/-TCC–11 (figs. 8 and 9).		

36. Equipment Performance Checklist, AN/TCC–11 Repeater—Continued

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	9	POWER switch on the TS–712/TCC–11.	Operate to ON position.	Meter indicates readings determined by positions of MEASURE switch.	Refer to paragraphs 23, 47, and 48.
	10	TS–712/TCC–11 and Telephone EE–8–( ).	Establish communication with attended point (par. 22). Request that 1 kc and 68 kc be sent over cable.		Check lightning arrestors. If trouble still exists, replace the AN/TCC–11.
	11	MEASURE switch on TS–712/TCC–11.	Operate to A BAT position.	Meter deflects to BAT mark.	Refer to paragraph 23.
	12	A BAT control on the TS–712/TCC–11.	Adjust to obtain meter reading at BAT mark.	Meter deflects to BAT mark.	Refer to paragraph 23.
	13	MEASURE switch on TS–712/TCC–11.	Operate to B BAT position.	Meter deflects to BAT mark.	Refer to paragraph 23.
	14	B BAT control on TS–712/TCC–11.	Adjust to obtain meter reading at BAT mark.	Meter deflects to BAT mark.	Refer to paragraph 23.
START	15	Telephone Repeater AN/TCC–11.	Starting is effected at attended points.		
EQUIPMENT PERFORMANCE	16	MEASURE switch on TS–712/TCC–11.	Operate to REP VOLTS position.	Meter deflects to BAT mark.	
	17	MEASURE switch on TS–712/TCC–11.	Operate to TRANS position.	Meter indicates readings as determined by position of SELECTOR switch.	Refer to paragraphs 25, 46, 47, and 48.
	18	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 1 IN 68 KC position.	Meter reads between −7 db and +7 db.	Refer to paragraph 37.
	19	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 1 OUT 68 KC position.	Meter reads between −5 db and +5 db.	Adjust GAIN AMP 1 control. Refer to paragraph 37.
	20	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 2 IN 68 KC position.	Meter reads between −7 db and +7 db.	Refer to paragraph 37.
	21	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 2 OUT 68 KC position.	Meter reads between −5 db and +5 db.	Adjust GAIN AMP 2 control. Refer to paragraph 37.
	22	SELECTOR switch on TS–712/TCC–11.	Operate the AMP 1 IN 1 KC and AMP 1 OUT 1 KC positions in turn.	If reading appears on meter, AMP 1 is carrying direction of transmission from attended point with which communication has been established. For values of readings under all conditions, see paragraph 24.	If reading is off scale, set OW GAIN switch to LOW position.

36. Equipment Performance Checklist, AN/TCC–11 Repeater—Continued

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PREFORMANCE	23	SELECTOR switch on TS–712/TCC–11.	Operate to AMP 2 IN 1 KC and AMP 2 OUT 1 KC positions, in turn.	If reading appears on meter, AMP 2 is carrying direction of transmission from attended point with which communication has been established. For values of readings under all conditions, see paragraph 24.	If reading is off scale, set OW GAIN switch to LOW position.
	24	MEASURE switch on TS–712/TCC–11.	Operate to V1 AMP 1, V2 AMP 1, V1 AMP 2, and V2 AMP 2 positions, in turn.	Meter reads between −2 db and +5 db in each case.	Replace AN/TCC–11 repeater.
	25	V ACT switch on TS–712/TCC–11.	Operate to TEST position, hold for 1 minute, note reading, release to NORMAL position for each position of MEASURE switch given in item 24.	Meter reads between −5 db and +5 db. Reading should be within 5 db of reading obtained in item 24.	Tag and replace AN/TCC–11 repeater.
STOP	26	POWER switch on TS–712/TCC–11.	Operate to off position		
	27	Connector P1 on TS–712/TCC–11.	Remove connector P1 of the TS–712/TCC–11 from connector J3 on AN/TCC–11 repeater.		
	28	Control access port covers and J3 connector cover on AN/TCC–11.	Replace and tighten securely.		
	29	Telephone EE–8–( )	Disconnect from TS–712/TCC–11 (par. 28).		
	30	Telephone Test Set TS–712/TCC–11.	Replace cover		

37. Organizational Level Troubleshooting Chart (AN/TCC–11) for Use at Unattended Point

The troubleshooting instructions given in this organizational level troubleshooting chart are to be applied only after trouble has been localized to a particular repeater. For instructions in localizing trouble to a repeater, refer to TM 11–2150. This organizational level troubleshooting chart lists only trouble symptoms that can be corrected at the unattended point. If trouble symptoms occur which are not listed, replace Telephone Repeater AN/TCC–11. Before performing any of the corrective measures listed in the chart, obtain permission from the operator at the attended point.

Symptom	Probable trouble	Correction
1. Low-voltage power alarm at attended point. Resistance measurements indicate a particular AN/TCC–11 in trouble. (Refer to TM 11–2150.)	Defective arrestors	Check arrestors E1, E2, E3, E4, E7, and E10 (par. 39). If arrestors are not defective, replace the AN/TCC–11 par. 38).
2. High-voltage power alarm at attended point. Resistance measurements indicate a particular AN/TCC–11 in trouble. (Refer to TM 11–2150.)	Faulty connection at connectors J1 or J2.	See that spiral-four cable connectors are seated securely in connectors J1 and J2.
	Dirty connector contacts	Clean connector contacts with solvent (SD) (par. 51). If connectors are seated securely, clean, and in good condition, but trouble persists, replace the AN/TCC–11 (par. 38).
3. No. 68–kc (par. 36, item 18) or 1-kc input (par. 36, item 22) to AMP 1 with repeater voltage normal (par. 36, item 16).	Defective arrestor E5	Check arrestor E5 (par. 39). If E5 is not defective, replace the AN/TCC–11 (par. 38).
4. No. 68–kc (par. 36, item 19) or 1-kc output (par. 36, item 22) from AMP 1 with normal 68–kc and 1-kc input.	Defective arrestor E8	Check arrestor E8 (par. 39). If E8 is not defective, replace the AN/TCC–11 (par. 38).
5. No. 68-kc (par. 36, item 20) or 1-kc input (par. 36, item 23) to AMP 2 with repeater voltage normal (par. 36, item 16).	Defective arrestor E9	Check arrestor E9 (par. 39). If E9 is not defective, replace the AN/TCC–11 (par. 38).
6. No. 68-kc (par. 36, item 21) or 1-kc output (par. 36, item 23) from AMP 2 with normal 68-kc and 1-kc input and repeater voltage normal (par. 36, item 16).	Defective arrestor E6	Check arrestor E6 (par. 39). If E6 is not defective, replace the AN/TCC–11 (par. 38).

38. Replacing Telephone Repeater AN/TCC–11

To replace Telephone Repeater AN/TCC–11 in an operating system, use the procedures outlined in *a* through *i* below.

a. Operate all controls on the substitute repeater to the same positions used on the repeater being replaced.

b. Tag or otherwise identify the spiral-four cable connectors to avoid inserting them into the wrong receptacles on the substitute repeater.

c. Establish contact with the operator at the attended point and obtain permission to interrupt service.

d. Request that the power to the repeater under test be turned off.

e. Disconnect the spiral-four cable connectors from connectors J1 and J2.

f. Insert the spiral-four cable connectors into corresponding connectors J1 and J2 on the new repeater.

g. Establish contact with the operator at the attended point and request that power be restored to the power loop.

h. Perform the equipment performance checks (par. 36).

i. Tag the replaced repeater as described in paragraph 33.

39. Replacing Lightning Arrestors in AN/TCC–11

Lightning arrestors in Telephone Repeater AN/TCC–11 may become damaged by the passage of surges of current induced in the cable by lightning or other sources. A damaged lightning arrestor may cause transmission or power failure. The lightning arrestors contain two carbon blocks. Both blocks are mounted with proper spacing in a removable bayonet-based container. When a lightning arrestor becomes damaged, the removable portion is replaced by one of the spares carried in Telephone Test Set TS–712/TCC–11. The procedure for replacing the removable portion of the arrestor is given in *a* through *i* below.

Warning: High voltage exists at the sockets of lightning arrestors marked with red lettering. Be very careful when working around the sockets of these arrestors.

a. Obtain permission from the operator at the attended point before removing any lightning arrestor. When removing a lightning arrestor, a short circuit may be created across the circuit to which the lightning arrestor socket is connected. Loosen the cap of the lightning arrestor holder by rotating the cap counterclockwise.

b. Remove the cap and the lightning arrestor.

c. Measure the resistance of the lightning arrestor with Multimeter TS–297/U or equivalent. Measure between the metal sleeve of the lightning arrestor and the outer carbon block. Push against the carbon block with the multimeter prod to be sure that the carbon block is seated normally. The normal resistance of a good arrestor is greater than 2 megohms. When using Multimeter TS–297/U, the meter reading should read between the 100,000-ohm mark and the infinity mark on the meter scale.

d. Inspect the lightning arrestor for evidence of damage, loose particles of carbon, and pitted surfaces.

e. Discard the removable portion of the lightning arrestor if it is defective.

f. Replace Telephone Repeater AN/TCC–11 (par. 38) if the portion of the lightning arrestor which cannot be removed is defective.

g. Select a new lightning arrestor from the spares in Telephone Test Set TS–712/TCC–11.

h. Measure the resistance of the new lightning arrestor (*c* above).

i. Match the color of the dot on the spare lightning arrestor to the color of the washer on the arrestor socket in Telephone Repeater AN/TCC–11, to make certain that the spare has the same voltage rating as the replaced lightning arrestor.

j. Insert the bayonet-type mounting of the lightning arrestor into the lightning arrestor socket.

40. Identification of Line Amplifiers in AN/TCC–11 Repeater

a. When Repeater Location is Known. When Telephone Repeater AN/TCC–11 is located in a power loop fed from the *A* attended point (see TM 11–2148), line amplifier AR1 is operating in the *A* to *B* direction, and line amplifier AR2 is operating in the *B* to *A* direction. When the AN/TCC–11 is located in a power loop fed from the *B* attended point, line amplifier AR1 is operating in the *B* to *A* direction, and line amplifier AR2 is operating in the *A* to *B* direction.

b. When Repeater Location is Not Known. When it is necessary to identify a particular line amplifier with the direction of transmission in which it is operating, use the following procedure:

(1) Connect Telephone Test Set TS–712/TCC–11 to Telephone EE–8–( ). Connect the test cable from the TS–712 test set to Telephone Repeater AN/TCC–11 (par. 17 and fig. 8).

(2) Establish communication with the operator at one attended point (par. 22) and request that the 1-kc test tone be sent over the line.

(3) Operate the MEASURE switch on the TS–712 test set to the TRANS position.

(4) Operate the SELECTOR switch on the test set to the AMP 1 IN 1 KC position and note the reading on the test set meter.

(5) If a reading is obtained in the test outlined in (4) above, request that the 1 kc be stopped and sent several times. If the meter reading shows a deflection each time, then line amplifier AR1 is operating in the direction from the attended point which is sending out the test tone (*A* to *B* when 1 kc is sent from the *A* attended point, and *B* to *A* when 1 kc is sent from the *B* attended point).

(6) If no reading is obtained in the test outlined in (4) above, operate the SELECTOR switch to the AMP 2 IN 1 KC position on the test set and note the reading on the test set meter.

(7) A 1,600-cycle tone may be used if the attended point is unable to supply 1 kc. Measure the 1,600-cycle tone on the test set meter. Use the procedures given in (1) through (6) above to identify the amplifier.

41. Performing 1 Kc Test

The readings under items 22 and 23 of the equipment performance checklist (par. 36) vary with the number of repeaters in the power loop, the position of the repeater in the power loop, the number of cable reels between the attended point and the first repeater, and the positions of the OW GAIN and 1 KC SENS switches on the TS–712/TCC–11. The readings that may be expected under all conditions are given in the table in paragraph 25*f*.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

42. General

The operation of Telephone Test Set TS–712/TCC–11 may be difficult in regions where extreme cold, heat, humidity, moisture, or sand conditions prevail. Paragraphs 43 through 45 contain instructions for minimizing the effects of these unusual operating conditions.

43. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. The shock-resistant characteristics of materials change at very low temperatures, and steel shrinks and becomes brittle. Handle the equipment with reasonable care.

b. Canvas will freeze and lose its pliability. Handle the carrying case strap carefully to avoid cracking the strap.

c. Extreme cold will cause wiring to become brittle. Handle the cables carefully.

d. When a TS–712 test set which has been exposed to the cold is brought into a warm room, moisture will condense on all cold surfaces and will continue to do so until the equipment reaches room temperature. When it reaches room temperature, dry it thoroughly.

44. Operation in Tropical Climates

When operated in tropical climates, the TS–712 test set may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground level, or when it is set up in swampy areas, moisture conditions are more acute than normal. Ventilation is very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature becomes lower than that of the ambient air. To minimize this condition, keep the equipment case cover fastened down (when the equipment is not in use) and covered with a tarpaulin or any available cover.

45. Operation in Desert Climates

a. Conditions similar to those in tropical climates often prevail in desert areas. Use the same measures described in paragraph 44 to insure proper operation of the equipment.

b. The main problem which arises with operation in desert areas is the large amount of sand and dust which enter the equipment. Though the TS–712 test set is mounted in a case, be careful to place the equipment in a location which is as dust-free as possible.

c. Never tie wiring connections to the inside or outside of tents. Desert areas are subject to sudden wind squalls which may jerk connections loose or break the lines.

Section IV. INITIAL ADJUSTMENTS AND TESTS

46. General

Before using the TS–712 test set for testing an AN/TCC–11 repeater, test and adjust the A-battery and the B-battery voltages (par. 23). Calibrate the transmission test circuit and test the output of the 1,600-cycle ringing oscillator at the AN/TCC–7 terminal or the AN/TCC–8 repeater as described in paragraphs 47 and 48.

47. Calibration Adjustments of Telephone Test Set TS–712/TCC–11 at AN/TCC–7 Terminal

(figs. 3 and 9)

a. Calibration of TS–712 Test Set Transmission Test Circuit.

(1) Test and adjust the A battery and the B

battery voltages in accordance with instructions in paragraph 23.

(2) Loosen the four corner screws on the top panel and pull the chassis out of the carrying case.

(3) Release connector P1 from the connector holder on the left side of the top panel.

(4) Connect connector P1 of the test set to connector J5 (TO TS–712/TCC–11 TEST SET) on the front panel of the TS–760 TEST PANEL of Telephone Terminal AN/TCC–7.

(5) Calibrate the TS–760 TEST PANEL at Telephone Terminal AN/TCC–7 according to the procedure described in TM 11–2139.

(6) Operate the SEND switch on the TS–760 TEST PANEL to the CHECK GAIN CHECK HF position.

(7) Operate the indicated controls of the TS–712 test set to the following positions:

(*a*) MEASURE switch to the TRANS position.

(*b*) SELECTOR switch to the AMP 2 IN 68 KC position.

(*c*) POWER switch to the ON position.

(8) Adjust the GAIN control on top of the bottom chassis of the TS–712 test set with a screwdriver until a reading of 0 db is obtained on the TS–712 test set meter.

(9) Disconnect connector P1 of the TS–712 test set from the TS–760 TEST PANEL and mount connector P1 on the connector holder.

(10) Push the chassis back into the carrying case and, at the same time, see that the front-panel gasket is seated properly. Then secure the chassis with the four corner screws on the top panel.

b. TS–712 Test Set 1,600-cycle Ringing Oscillator Test.

(1) Perform the steps indicated in *a*(1), (3), (4), and (5) above.

(2) Connect terminals L1 and L2 of Telephone EE–8–( ) to TEL binding posts L1 and L2, respectively, of the TS–712 test set.

(3) Operate the indicated controls of the TS–712 test set to the following positions:

(*a*) MEASURE switch to the TRANS position.

(*b*) SELECTOR switch to the AMP 1 IN 1 KC position.

(*c*) ORDER WIRE switch to the RING position.

(*d*) OW GAIN switch to the HIGH position.

(*e*) POWER switch to the ON position.

(4) Turn the crank of Telephone EE–8–( ) at a speed of about 200 revolutions per minute (rpm), for several seconds. The TS–712 test set meter should read between −4 db and +4 db.

(5) Disconnect connector P1 of the TS–712 test set from the TS–760 TEST PANEL and mount connector P1 on the connector holder.

(6) Replace the cover on the carrying case, fasten the snap catches, and tighten the carrying strap.

48. Calibration Adjustments of Telephone Test Set TS–712/TCC–11 at AN/TCC–8 repeater

(figs. 3 and 9)

a. Calibration of TS–712 Test Set Transmission Test Circuit.

(1) Test and adjust the A-battery and the B-battery voltages in accordance with the instructions given in paragraph 23.

(2) Loosen the four corner screws on the top panel and pull the chassis out of the carrying case.

(3) Release connector P1 from the connector holder on the left side of the top panel.

(4) Connect connector P1 of the test set to Connector J5 (TO TS–712/TCC–11 TEST SET) on the front panel of the TS–761 TEST PANEL of Telephone Repeater AN/TCC–8.

(5) Calibrate the TS–761 TEST PANEL at Telephone Repeater AN/TCC–8 according to the procedure described in TM 11–2148.

(6) Operate the SEND DIRECTION switch on the TS–761 TEST PANEL to the CHECK position and the SEND FREQUENCY switch to the 68 KC position.

(7) Operate the indicated controls of the TS–712 test set to the following positions:

(*a*) MEASURE switch to the TRANS position.

(*b*) SELECTOR switch to the AMP 2 IN 68 KC position.

(*c*) POWER switch to the ON position.

(8) Adjust the GAIN control on the test set with a screwdriver until a reading of 0 db is obtained on the TS–712 test set meter.

(9) Disconnect connector P1 of the TS–712 test set from the TS–761 TEST PANEL and mount connector P1 on the connector holder.

(10) Push the chassis back into the carrying case and, at the same time, see that the front-panel gasket is seated properly. Then secure the chassis with the four corner screws on the top panel.

b. TS–712 Test Set 1,600-cycle Ringing Oscillator Test.

(1) Perform the steps indicated in *a* (1), (3), (4), and (5) above.

(2) Connect terminals L1 and L2 of Telephone EE–8–( ) to TEL binding posts L1 and L2 respectively of the TS–712 test set.

(3) Operate the controls of the TS–712 test set to the following positions:

(*a*) MEASURE switch to the TRANS position.

(*b*) SELECTOR switch to the AMP 1 IN 1 KC position.

(*c*) ORDER WIRE switch to the RING position.

(*d*) OW GAIN switch to the HIGH position.

(*e*) POWER switch to the ON position.

(4) Turn the crank of Telephone EE–8–( ) at a speed of about 200 rpm, for several seconds. The TS–712 test set meter should read between −4 db and +4 db.

(5) Disconnect connector P1 of the TS–712 test set from the TS–761 TEST PANEL and mount connector P1 on the connector holder.

(6) Replace the cover on the carrying case, fasten the snap fasteners, and tighten the carrying strap.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

49. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair because its object is to prevent certain troubles from occurring. Refer to AR 750–5.

50. Tools, Materials, and Test Equipment Required

No tools, materials, or test equipment are issued for use with Telephone Test Set TS–712/TCC–11 in performing organizational maintenance. These items are not necessary to perform preventive maintenance or for organizational trouble shooting.

51. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

Caution: Do not use emery cloth or steel wool. Minute particles frequently enter the connector receptacles and cause harmful shorting or grounding of circuits.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a dry cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

Caution: Repeated contact of carbon tetrachloride with the skin, or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

52. Use of Preventive Maintenance Forms

(figs. 11 and 12)

a. Figures 11 and 12 are presented as a guide to the individual making an inspection of equipment in accordance with instructions on DA Forms 11–238 and 11–239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative. In the case of second and third echelon maintenance, the decision is to be made by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Items which are relevant to Telephone Test Set TS–712/TCC–11 are circled on figures 11 and 12, and cross references between the item numbers of DA Forms 11–238 and 11–239 and the preventive maintenance information in this manual are indicated by paragraph references, and items on the forms.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* (PAR. 50)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. (PAR. 13)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. (PAR. 57)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. (PAR. 56)							
6	CHECK FOR NORMAL OPERATION. (PAR. 59)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. (PAR. 50)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. (PAR. 53)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. (PAR. 50)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. (PAR. 57)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. (PAR. 57)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. (PARS. 53 AND 54)		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. (PAR. 56)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA AGO FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

Figure 11. DA Form 11–238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (1) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* (PAR. 50)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. (PAR. 13)	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. (PAR. 57)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. (PAR. 56)	
6	CHECK FOR NORMAL OPERATION. (PAR. 59)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. (PAR. 50)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. (PAR. 53)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. (PAR. 57)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING. (PARS. 53 AND 54)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. (PAR. 56)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. (PAR. 50)	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. (PAR. 57)	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. (PAR. 57)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. (PAR. 57)	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. (PAR. 56)	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. (PAR. 57)	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. (PAR. 57)	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. (PAR. 50)	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. (PAR. 56)	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. (PAR. 56)	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS. (PAR. 23)	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
37	MOISTURE AND FUNGIPROOF.	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA AGO FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—44382-1

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Figure 12. DA Form 11–239.

53. Lubrication

Telephone Test Set TS–712/TCC–11 requires no lubrication. All moving parts are inclosed within a watertight seal.

54. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive mositure, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75.

e. Moistureproofing and Fungiproofing. Moistureproofing and fungiproofing are done during manufacture and do not have to be repeated unless the parts are repaired or replaced.

55. Rustproofing and Painting

a. When the finish on exposed metal surfaces has been scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touchup job is necessary, apply paint with a small brush. Remove corrosion from the surface to be painted by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistant with existent regulations.

56. Refinishing

Rustproofing instructions for metal parts are given in paragraph 55 and in TB SIG 23. Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9–2851.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

57. General

a. The troubleshooting and repairs that can be performed at the organizational level (operators and repairmen) are necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out parts or other visibly damaged parts.

b. Paragraphs 58 through 60 contain information to help in determining whether the trouble is in the TS–712 test set or in the Telephone EE–8–( ).

58. Visual Inspection

a. If the TS–712 test set fails to test or calibrate properly at an AN/TCC–7 terminal or at an AN/TCC–8 repeater, as described in paragraphs 47 and 48, the trouble may be caused by one or more of the following faults:

(1) Defective TS–760 TEST PANEL in AN/TCC–7 terminal or defective TS–761 TEST PANEL in AN/TCC–8 repeater.
(2) Test cable disconnected from connector P1.
(3) Wires broken or corroded.
(4) Defective A or B battery.
(5) Defective tubes or transistor.
(6) Defective switches.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the parts of the TS–712 test set. If possible, obtain information regarding performance at the time trouble occurred.

59. Sectionalization of Trouble

Sectionalization of trouble consists of determining whether the trouble is in the main chassis of the TS–712 test set, in the Telephone EE–8–( ), or in the artificial cable. Operate the equipment in

accordance with the equipment performance checklists (par. 60) and observe any abnormal indications.

60. Equipment Performance Checklists

The equipment performance checklists in *e* and *f* below apply to the performance of TS–712 test set when it is being adjusted and tested at the AN/TCC–7 terminal or at the AN/TCC–8 repeater.

a. General. The equipment performance checklists below will help the operator to locate the trouble in the equipment. Each list gives the item to be checked, the conditions under which the item is checked, the normal indications and the tolerances of correct operation, and the corrective measures to be taken. *To use these lists, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible indications that should be perceived when each item is checked. If the indications are not normal, apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those which the operator can make without turning in the equipment for repairs. If the equipment is inoperative or if the recommended corrective measures do not yield results, troubleshooting at the field maintenance level is necessary. However, if the tactical situation requires that communication be maintained from an AN/TCC–11 repeater and if the TS–712 test set is faulty but not inoperative, the operator must maintain the TS–712 test set in operation as long as it is possible to do so.

e. Equipment Performance Checklist of TS–712 Test Set for Use at AN/TCC–7

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cable W1 on TS–712 test set.	Connector P1 inserted into connector J5 on front panel of TS–760 TEST PANEL.		
	2	TS–760 TEST PANEL SEND switch.	Operated to CHECK GAIN CHECK HF position.		
	3	SELECTOR switch	Operated to AMP 2 IN 68 KC position.		
	4	TEL binding posts L1 and L2.	Connected to binding posts L1 and L2 of field Telephone EE–8–( ).		
	5	ORDER WIRE switch	Operated to RING position.		
	6	OW GAIN switch	Operated to HIGH position.		
START	7	POWER switch	Operated to ON position		

60. Equipment Performance Checklists—Continued

e. Equipment Performance Checklist of TS–712 Test Set for Use at AN/TCC–7—Continued

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	8	MEASURE switch	Operated to A BAT position.	Meter pointer deflects to BAT mark.	Adjust A BAT control. Replace A battery. Substitute spare 1U5 tube, first for V1 and then for V2 tube.
	9	MEASURE switch	Operated to B BAT position.	Meter pointer deflects to BAT mark.	Adjust B BAT control. Replace B battery. Substitute spare 1U5 tube, first for V1 and then for V2 tube.
	10	MEASURE switch	Operated to TRANS position.	Meter pointer deflects to 0 db mark.	Adjust GAIN control.
	11	SELECTOR switch	Operated to AMP 1 IN 1 KC position.	----------	
	12	Hand generator of Telephone EE–8–( ).	Crank operated at normal speed of about 200 rpm.	Meter pointer deflects to range of −4 db and +4 db.	Check Telephone EE–8–( ) hand generator output voltage. Check transistor.
STOP	13	POWER switch	Operated to off position	Meter pointer deflects to rest mark.	

60. Equipment Performance Checklists—Continued

f. Equipment Perfomance Checklist of TS–712 Test Set for Use at AN/TCC–8.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cable W1 on TS–712 test set.	Connector P1 inserted into connector J5 on front panel of TS–761 TEST PANEL.	----------	
	2	SEND DIRECTION switch on TS–761 TEST PANEL.	Operated to CHECK position.	----------	
	3	SEND FREQUENCY switch on TS–761 TEST PANEL.	Operated to 68 KC OR CHECK position.	----------	
	4	Repeat items 3 through 6 in *e* above.	----------	----------	
START	5	POWER switch on TS–712 test set.	Operated to ON position	----------	
EQUIP. PERF.	6	Repeat items 8 through 12 in *e* above.	----------	----------	
STOP	7	POWER switch on TS–712 test set.	Operated to off position	Meter pointer deflects to rest mark.	

CHAPTER 5
THEORY OF TELEPHONE TEST SET TS–712/TCC–11

Section I. INTRODUCTION

61. General

a. Telephone Test Set TS–712/TCC–11 is a portable test set which is used to perform maintenance checks on the AN/TCC–11 repeater while the repeater is in operation at an unattended point in a system. Preinstallation tests and maintenance tests also can be made on the AN/TCC–11 at attended locations (AN/TCC–7 or AN/TCC–8) by using the TS–712 test set. The TS–712 test set contains transmission test circuits which are used to measure signal and d-c voltages at various test points in the circuits of the AN/TCC–11 repeater. The transmission test circuits of the TS–712 test set are connected to these test points through cable W1 and are terminated in connector P1 which, in use, is inserted into test jack connector J3 located on one end panel of the AN/TCC–11 repeater (fig. 42). The results of the measurements are indicated on a meter located on the top panel of the TS–712 test set.

b. To facilitate maintenance checks, an order-wire circuit is included which permits talking and signaling from the remote location. This circuit is used in conjunction with Telephone EE–8( ).

c. An artificial cable is supplied as part of the TS–712 test set. The artificial cable is used to check Telephone Repeater AN/TCC–11 at an attended point.

62. Block Diagram

(fig. 13—See foldin in back of Manual)

Figure 13 is a functional block diagram of the TS–712 test set. The block diagram shows the transmission test circuit, the order-wire circuit, and the artificial cable, which is in a separate metal case.

63. Transmission Test Circuit, General Function

(fig. 13)

The transmission test circuit performs five test functions: 1-kc (or 1.6-kc) and 68-kc signal transmission tests, a repeater d-c voltage test, a repeater vacuum-tube activity test, an A-battery test (TS–712 test set), and a B-battery test (TS–712 test set).

a. Repeater Transmission Test. SELECTOR switch S1 permits the selection of transmission test points (through cable W1 and connector P1) in the AN/TCC–11 repeater. Measurements of the 68-kc or 1-kc signal at the proper points provide an indication of the condition of the repeater. For 68-kc measurements, band-pass filter FL1 attenuates carrier channel signals in the 12- to 60-kc band which are present with the desired 68-kc pilot frequency. For 1-kc measurements, the signals are applied through the SELECTOR switch to 1 KC SENS switch S2, which adjusts the sensitivity of the transmission test circuit for a wide range of 1-kc input voltages. The signals then are applied to 1- to 1.6-kc band-pass filter FL2, which attenuates other frequencies present and passes the 1-kc test signal. The output of either FL1 or FL2 is applied, through a section of SELECTOR switch S1 (fig. 43), not shown on the block diagram, to transmission test amplifier tubes V1 and V2 (fig. 13). Tubes V1 and V2 amplify the signal under test to the level required to produce proper indication on the meter. The amplified 1-kc or 68-kc signal is applied to the meter rectifier, which is a diode section of tube V2. The rectified signal voltage is applied, through MEASURE switch S3 in the TRANS position, to meter M1.

b. Repeater D-C Voltage Test. To test the repeater d-c voltage (power circuit), MEASURE switch S3 is operated to the REP VOLTS position. Connection then is made, through cable W1 and connector P1, to the d-c voltage supplying the filament and plate tube circuits of the repeater under test. The results of the test are indicated on M1.

c. Repeater Vacuum-Tube Activity Test. The vacuum-tube activity test indicates the condition of the tube under test. To make a repeater vacuum-tube activity test, MEASURE switch S3 is operated to the V1 AMP 1, V2 AMP 1, V1

AMP 2, or V2 AMP 2 position, as required. The tube tested is indicated by the panel marking of the MEASURE switch. The test is completed by operating nonlocking V ACT switch S7. Operation of S7 produces a slight reduction in the voltage applied to the AN/TCC–11 repeater circuits and tube filaments. The reduction in voltage is not normally sufficient to disturb operation of the line amplifiers in the repeater, but is enough to determine the condition of the tubes.

d. A-Battery Test. The A-battery test (TS–712 test set) is used to check and adjust the filament voltage of transmission test amplifiers V1 and V2. The test is made by operating the MEASURE switch to the A BAT position and adjusting the A BAT control so that the meter reads at the BAT mark on the scale.

e. B-Battery Test. The B-battery test is used to check and adjust the plate and screen voltages of transmission test amplifiers V1 and V2 (TS–712 test set). The test is made by operating the MEASURE switch to the B BAT position and adjusting the B BAT control so that the meter pointer deflects to the BAT mark.

64. Order-Wire Circuit, General Function

(fig. 13)

The order-wire circuit of the TS–712 test set is used with field Telephone EE–8–( ) to ring and talk from an AN/TCC–11 repeater.

a. Ringing Signal. To ring, the handcrank of Telephone EE–8–( ) is turned with ORDER WIRE switch S5 in the RING position. The 20-cycle output of the telephone is applied to varistor CR5, which limits the input voltage to a constant value despite variations in cranking speed. The limited voltage is applied to rectifiers CR1, CR2, CR3, and CR4, which convert the alternating-current (a-c) voltage to dc. The d-c voltage energizes 1,600-cps ringing oscillator transistor Q1. The 1,600-cycle output of Q1 is applied to transformer T1 and OW GAIN switch S6. The position of the OW GAIN switch depends on the distance the order-wire signal must travel to reach the operator at the attended point. From the OW GAIN switch the ringing signal is applied to the order-wire circuits of the AN/TCC–11 repeater.

b. Talking and Listening. To talk and listen, the ORDER WIRE switch is operated to the TALK position. This connects the voice signals from Telephone EE–8–( ) to ring-talk transformer T3, to OW GAIN switch S6, and to the order-wire circuits of the AN/TCC–11 repeater. The voice signals from the repeater circuits are applied to Telephone EE–8–( ) in reverse order.

65. Artificial Cable, General Function

(fig. 13)

The artificial cable simulates the transmission losses of 5¾ miles of spiral-four cable. The artificial cable is composed of two line-matching transformers (Z1) T1 and (Z1) T2, and cable simulating network (Z1) Z1. The artificial cable is used when checking an AN/TCC–11 repeater at an attended point (AN/TCC–7 or AN/TCC–8). The spiral-four connector of the artificial cable (fig. 4) is inserted in one end of the AN/TCC–11 repeater for the test.

66. A- and B-Battery Power Supply, General Function

(fig. 13)

The tubes of the TS–712 test set are energized by batteries. A 1.5-volt A battery energizes the filaments and a 90-volt B battery supplies plate voltage.

Section II. THEORY OF TRANSMISSION TEST CIRCUIT

67. Repeater Transmission Tests

(figs. 42 and 43)

a. Measurement of the 68-kc pilot frequency provides an indication of the transmission gain and proper operation of the 12-kc to 60-kc carrier channels over which communication is maintained. Measurement of the 1-kc or 1.6-kc test tone provides an indication of continuity of the order-wire circuit through the AN/TCC–11 repeater, and also enables the lineman to determine the direction of order-wire transmission through the repeater.

b. To make all tests on the AN/TCC–11 repeater, connector P1 of the test set (fig. 3) is inserted into connector J3 on the J1 end cover assembly of the repeater (fig. 7). Connections from the AN/TCC–11 repeater circuits to SELECTOR switch S1 (fig. 43) and the transmission test circuit are made through test set connector P1 and repeater connector J3. A detailed description of the switch positions and tests appears in paragraphs 68 through 97.

c. The TS–712 test set measures the 68-kc or 1-kc transmission at high-pass, low-pass filters

FL1, FL2, FL3, and FL4 at both ends of line amplifiers AR1 and AR2 in the AN/TCC–11 repeater (fig. 42). Each pair of transmission leads carrying signal frequencies at these points has one side grounded to the repeater filter-section chassis and the line-amplifier chassis, which is indicated by a panel-ground symbol (see note 3, figure 42). Under certain conditions, the panel ground may be several hundred volts positive with respect to the cylindrical case of the AN/TCC–11 repeater and the panel and chassis of the TS–712 test set. To keep the high positive voltage from the TS–712 test set panel, the ground side of the a-c signal path from the TS–712 test set chassis is returned to repeater panel ground (pin M, connector P1 on the test set) through capacitor C8 of the TS–712 test set (fig. 43). D-c blocking capacitors C1, C2, C5, and C6 keep the high positive d-c voltage from the transmission test circuit.

68. Transmission Test, SELECTOR Switch S1

(fig. 43)

a. SELECTOR switch S1 (fig. 43) connects the transmission test circuit to repeater input filters FL1 and FL3 (fig. 42) for making 1-kc and 68-kc input measurements (AMP 1 IN 1 KC, AMP 1 IN 68 KC, AMP 2 IN 1 KC, AMP 2 IN 68 KC positions) (fig. 43). SELECTOR switch S1 also connects the transmission test circuit to repeater output filters FL2 and FL3 (fig. 42) for making 68-kc and 1-kc output measurements (AMP 1 OUT 1 KC, AMP 1 OUT 68 KC, AMP 2 OUT 1 KC, AMP 2 OUT 68 KC positions) (fig. 43). The eight positions of the SELECTOR switch are described in paragraphs 69 through 76.

b. To make all transmission test measurements, MEASURE switch S4 (fig. 43) must be in the TRANS position.

69. SELECTOR Switch S1, AMP 1 IN 1 KC Position

(fig. 43)

a. In the AMP 1 IN 1 KC position of the SELECTOR switch, the 1-kc test signal is taken from terminal 1 of repeater input filter FL1, which faces the input of line amplifier AR1 (fig. 42). At this point, the carrier channel signals, the 68-kc pilot, and the 1-kc test signal are present. These signals are applied to pins 9 of J5 and P2, and then to pin A of connector J3 in the repeater. The signals enter pin A of connector P1 on the TS–712 test set (fig. 42), and are applied to d-c blocking capacitor C1. From capacitor C1, the signals are applied to terminals 1 and 2 of section 3 and then to section 2 of the SELECTOR switch (fig. 43).

b. From terminal 1 of section 2, the signals are applied through 1 KC SENS switch S2 (par. 77) to 1- to 1.6-kc band-pass filter FL2 (par. 78). The 1-kc test signal is applied to the voltage divider consisting of resistor R7 and variable resistor R8. Variable resistor R8 is adjusted during manufacture and at field maintenance only. The 1-kc test signal is applied to terminals 1, 4, 5, and 8, of section 1 of the SELECTOR switch. From terminal 12 of section 1, the 1-kc signal is applied to the grid of tube V1.

70. MEASURE Switch S2, AMP 1 IN 68 KC Position

(figs. 42, 43)

In the AMP 1 IN 68 KC position of the SELECTOR switch, the 68-kc pilot signal is taken from terminal 1 of repeater input filter FL1 (fig. 42) and passed through the connectors to d-c blocking capacitor C1 (fig. 43) as described in paragraph 69. The signals then are connected through SELECTOR switch sections 3 and 2 to 68-kc band-pass filter FL1 (par. 79). Capacitor C7, which is adjusted during manufacture and during field maintenance, tunes the output of filter FL2 for maximum 68-kc transmission. The 68-kc output is connected through section 1 of the SELECTOR switch to V1 control grid (par. 80).

71. SELECTOR Switch S1, AMP 1 OUT 68 KC Position

(fig. 43)

a. In the AMP 1 OUT 68 KC position of the SELECTOR switch, the 68-kc signal, which has been amplified and regulated in the circuits of the AN/TCC–11 repeater, is taken from terminal 1 of output filter FL4 (fig. 42) and is passed through pins 5 of J5 and P2 to pin C of connector J3 in the AN/TCC–11 repeater. From pin C of connector P1 of the TS–712 test set (fig. 43), the signal is applied to d-c blocking capacitor C5, to resistor R1, and then to terminal 3, section 3 of the SELECTOR switch.

b. With SELECTOR switch S1 in the AMP 1 OUT 68 KC position, resistors R1 and R4 form an attenuator. The 68-kc signal developed across R4 is applied through switch S1, section 2 to terminal 1 (input) of 68-kc band-pass filter FL1. Resistor R4 is approximately one-twelfth the size of resistor R1 and the signal to be tested is approx-

imately one-twelfth of the signal amplitude at the input of line amplifier AR1. The signal attenuation introduced by R1 and R4 is 23 db, which is equal to the amplification that normally occurs in the AN/TCC–11 repeater line amplifier. The purpose of this attenuator is to simplify the use of the test-indicating meter by producing the same reading on the meter scale for both the 68-kc input and the output measurements. The output of the 68-kc band-pass filter then is applied through section 1 of the SELECTOR switch to V1 control grid.

72. SELECTOR Switch S1, OUT 1 KC AMP 1 Position

(fig. 43.)

In the OUT 1 KC AMP 1 position of the SELECTOR switch, the 1-kc signal which has been bypassed around line amplifier AR1 (fig. 42), is passed through pins 5 of J5 and P1, and pin C of J3 on the AN/TCC–11 repeater, through pin C of P1 on the test set (fig. 43), through blocking capacitor C5 to terminal 4, section 3 of the SELECTOR switch. The signal is passed, without attenuation, to section 2 of S1, to 1 KC SENS switch S2, to 1- to 1.6-kc band-pass filter FL2, to R7 and R8, through section 1 of the SELECTOR switch, and to V1 control grid. The signal then is amplified, rectified, and passed on through the MEASURE switch (par. 83), through the POWER switch, to meter M1.

73. SELECTOR Switch S1, IN 1 KC AMP 2 Position

(fig. 43)

a. In the IN 1 KC AMP 2 position of the SELECTOR switch, the 1-kc test signal is taken from terminal 1 of repeater input filter FL3, which faces the input of line amplifier AR2 (fig. 42). At this point, the carrier channel signals, the 68-kc pilot, and also the 1-kc test signal (when sent) are present. These signals are applied to pins 5 of connectors J6 and P3, and are passed on to pin R of connector J3 in the repeater. From J3, the signals enter pin R of connector P1 of the TS–712 test set (fig. 43), and are applied to d-c blocking capacitor C2. From C2, the signals are applied to terminals 6 and 7, section 4, of SELECTOR switch S1.

b. From terminal 4, section 4, the signal goes to section 2, to the 1 KC SENS switch S2, and to the 1- to 1.6-kc band-pass filter. The carrier frequency signals are rejected by this filter, and the 1-kc test signal is passed on to the attenuator consisting of resistors R7 and R8. From terminal 2 of variable resistor R8, the signal is applied to terminal 5 and 1, 4, 8 of section 1 of the SELECTOR switch.

c. From terminal 12 of section 1 the 1-kc signal is applied to V1 control grid.

74. SELECTOR Switch S1, IN 68 KC AMP 2 Position

(fig. 43)

a. In the IN 68 KC AMP 2 position of the SELECTOR switch, the 68-kc pilot signal is taken from terminal 1 of repeater input filter FL3 (fig. 42), through pins 5 of connectors J6 and P3 respectively, through pin R of the repeater test connector J3, through pin R of TS–712 test set connector P1 (fig. 43), to capacitor C2, as described in the preceding paragraph.

b. The signals are passed through C2 to terminal 7 (and 6), section 4 of SELECTOR switch S1. From terminal 4, section 4, the signal is passed to terminal 12, section 2. From terminal 6, section 2, the 68-kc signal is applied to the 68-kc band-pass filter, and on to the remainder of the circuit, as described in paragraph 70.

75. SELECTOR Switch S1, OUT 68 KC AMP 2 Position

(fig. 43)

In the OUT 68 KC AMP 2 position of the SELECTOR switch, the 68-kc and carrier signals, which have been amplified in line amplifier AR2 of the repeater, are taken from terminal 1 of output filter FL2. The signals are passed to pins 14 of J6 and P3 and on to pin E of connector J3 on the repeater (fig. 42). From pin E of P1 of the TS–712 test set (fig. 43), the signals are passed through capacitor C6 and through resistor R3 to terminal 8, section 4 of SELECTOR switch S1. From terminal 4, section 4, the signals are applied to one end of resistor R2 and to terminal 12, section 2, of the same switch. The other end of resistor R2 is grounded through terminal 5, section 3, forming a 23-db attenuator for the 68-kc signal. From terminal 7, section 2, the signals are applied to 68-kc band-pass filter FL1, and to the remainder of the circuit, as described in paragraph 70.

76. SELECTOR Switch S1, OUT 1 KC AMP 2 Position

(fig. 43)

In this position of the SELECTOR switch, the 1-kc signal, which has been bypassed around line amplifier AR2 (fig. 42), is passed through the repeater circuits, the TS–712 test set connector, and capacitor C6 in the test set (fig. 43). From capacitor C6, the signal is applied to terminal 9, section 4 of SELECTOR switch S1; and from terminal 4 of the same section, the signal goes to terminal 12 of section 2. From terminal 8 of the same section, the signal is passed to the 1 KC SENS switch S2, to the 1- to 1.6-kc band-pass filter, and through section 1 of the SELECTOR switch to V1 control grid.

77. Transmission Test, 1 KC SENS Switch S2

a. In the HIGH position, the 1 KC SENS switch places the transmission test circuit in the condition of highest sensitivity. In this position of switch S2, the 1-kc signals from section 2 of SELECTOR switch S1 are applied through the contacts of the 1 KC SENS switch to terminal 1 input of 1- to 1.6-kc band-pass filter FL2.

b. When using the TS–712 test set to check an AN/TCC–11 repeater, the sensitivity of the 1-kc transmission test circuit may be so high that it produces an off-scale reading. In this case, the 1 KC SENS switch is operated to LOW. In the LOW position of the switch, the 1-kc signals from section 2 of SELECTOR switch S1 are applied, through the contacts of the 1 KC SENS switch, to the attenuator consisting of resistors R6 and R5. The 1-kc signal voltage developed across resistor R5 is used for measuring. The attenuator produces a 20-db reduction in the signal. Refer to paragraph 84*b* for a detailed description of the meter readings obtained during 1-kc transmission tests.

78. Transmission Test, 1- to 1.6-kc Band-Pass Filter FL2

(fig. 14)

a. During 1-kc transmission tests the signals from the 1 KC SENS switch are applied to input terminal 1 of filter FL2. These signals contain the 1-kc test frequency, the 12- to 60-kc carrier channel frequencies, and the 68-kc pilot. The 1- to 1.6-kc band-pass filter attenuates frequencies below 500 cycles and above a few kc very sharply, essentially passing only the 1-kc test signal. Figure 14 is a schematic diagram of filter FL2.

b. The filtered 1-kc test signal output appears across the attenuator composed of resistor R7 and variable resistor R8. The 1-kc test voltage is taken from terminal 2 of variable resistor R8, which is adjusted during manufacture and field maintenance, to provide the proper sensitivity of 1-kc measurements (par. 24). The voltage from resistor R8 is applied to V1 control grid (par. 80).

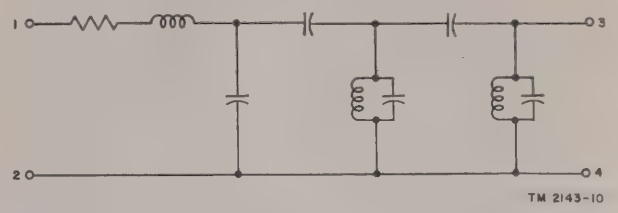


Figure 14. TS–712 test set, 1- to 1.6-kc band-pass filter FL2, schematic diagram.

79. Transmission Test, 68-kc Band-Pass Filter FL1

(fig. 15)

a. The signals at the test points of the AN/TCC–11 repeater contain order-wire voice frequencies, carrier channel frequencies from 12 to 60 kc, and the 68-kc pilot. The 68-kc band-pass filter (FL1) heavily attenuates those frequencies below 60 kc and above 80 kc so that all other frequencies present, including fault-locating frequencies of 83, kc 91 kc, and 99 kc will not interfere with measurement of the 68-kc pilot frequency. Figure 15 is a schematic diagram of filter FL1.

b. The essentially pure 68 kc appears at terminals 3 and 4 of filter FL1, and across capacitor C7. Capacitor C7, together with stray wiring capacitance, tunes the output of filter FL1 to 68 kc. This adjustment is made during manufacture and at field maintenance (par. 143).

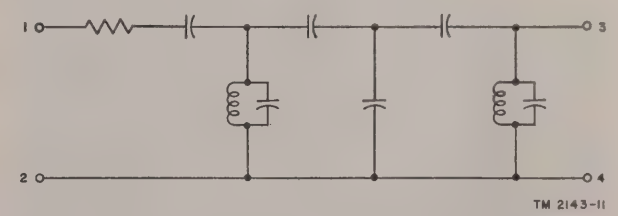


Figure 15. TS–712 test set, 68-kc band-pass filter FL1.

80. Transmission Test, First Amplifier V1

a. First amplifier VI (fig. 43) is the diode-pentode vacuum tube 1U5. The filament is heated directly by the A battery. The diode section of the tube is not used; the pentode section is used as an amplifier of the 68-kc or 1-kc signal

frequency. A d-c filament voltage of 1.2 volts is applied across the filament (cathode). Since 1.2 volts is at one side of the filament and 0 volt is at the grounded side of the filament, the average d-c potential of the filament to ground is +.6 volt. The control grid, which is connected to d-c ground through resistor R9, is .6 volt negative with respect to the filament. This .6-volt bias exists between the control grid and the d-c center point on the filament, and cannot be measured.

b. The 1-kc or 68-kc signal is impressed on the V1 control grid by direct coupling from the output of filters FL1 or FL2 through section 1 of SELECTOR switch S1. Resistor R10 is the plate load variable resistor across which the amplified signal voltage is developed. Resistor R10 also is used as the 68-kc GAIN control. The control is adjusted when the TS–712 test set is calibrated at Telephone Terminal AN/TCC–7 or Telephone Repeater AN/TCC–8. Capacitor C9 couples the signal to V2 control grid.

81. Transmission Test, Second Amplifier V2 Pentode

(fig. 43)

a. Second amplifier V2 uses the diode-pentode 1U5 with a battery-heated filament. The diode section of this tube is used as a meter rectifier and is described in paragraph 82. The pentode section obtains a grid bias voltage of —.6 volt as explained in paragraph 80. Resistor R11 provides a d-c path to ground for V2 control grid.

b. The amplified signal voltage of tube V2 is coupled to the secondary of transformer T1.

82. Transmission Test Meter Rectifier V2 Diode

(fig. 43)

a. Meter rectifier V2 diode (fig. 43) is a half-wave rectifier which uses the diode section of the diode-pentode 1U5. The directly heated filament serves both sections of the tube. The amplified 68 kc or 1 kc from second amplifier V2 appears across the secondary of transformer T1. The diode and meter M1 are connected in series with the secondary of transformer T1. The plate of the diode is connected to terminal 2 of the secondary. Terminal 1 of the secondary is connected through section 4 of MEASURE switch S3 (in the TRANS position) and through POWER switch S4 (in the ON position) to the negative side of meter M1. The POWER switch connects the positive side of meter M1 to ground through section 3 of the MEASURE switch. Chassis ground completes the circuit connection to the diode at pin 1. The diode conducts only when the signal voltage makes the diode plate of V2 positive in relation to the filament. Current, therefore, is permitted to pass through the meter in one direction only.

b. Resistor R12 reduces the impedance load on alternate cycles when the diode is not conducting. The effect of the load resistor is to provide a termination for T1 so that its primary presents the proper load for the diode.

c. The meter indications for 68-kc and 1-kc transmission tests are described in paragraph 84*a* and *b*.

83. Test Indicating Meter M1

(fig. 43)

Test indicating meter M1 is a 100-microampere meter with an internal impedance of 1,000 ohms. When POWER switch S4 is in the off position, the meter terminals are shorted, effectively damping its action. With switch S4 in the ON position, the meter is placed in the various transmission test circuits by MEASURE switch S3.

a. In the TRANS position of the MEASURE switch the meter indicates the amplitude of the 68-kc or 1-kc transmission frequencies.

b. In positions REP VOLTS, A BAT, B BAT, V1 AMP 1, V2 AMP 1, V1 AMP 2, and V2 AMP 2 of the MEASURE switch, the meter is used as a voltmeter for d-c voltage and filament activity test measurements.

c. The various positions of the MEASURE switch are described in detail in paragraphs 86 through 94.

84. Transmission Tests, Test Indicating Meter Readings

a. The correct meter indication for a 68-kc transmission test is 0 db. This meter indication is the same for all four positions of the SELECTOR switch pertaining to 68-kc measurements. In practice, deviations of ±7 db are allowed for the 68-kc input readings and deviations of ±5 db are allowed for the 68-kc output readings.

b. The meter indication for a 1-kc transmission test is not a fixed value. It varies with the distance of the AN/TCC–11 repeater (which does not amplify order-wire frequencies) from the sending AN/TCC–7 terminal. The purpose of the 1-kc transmission test is to measure the amplitude of the 1-kc test tone, to test the continuity of the order-wire circuit through the

repeater and to determine which line amplifier is operating in the transmission direction and which in the opposite transmission direction.

c. The meter indications for the AN/TCC–11 repeater voltage test, the A-battery and B-battery tests, and the vacuum-tube activity tests are given in paragraphs 21 through 27 which describe these tests.

85. A- and B-Battery Power Supply Circuits

(fig. 43)

The power supply for the transmission test amplifier tube consists of an A battery for filament voltage and a B battery which furnishes plate and screen voltage to amplifiers V1 and V2.

a. A-Battery Power Supply Circuit.

(1) Figure 43 shows the A-battery power supply circuit. Positive 1½ volts is delivered to the TS–712 test set on pin 2 of connector P2. The negative side of the battery is connected to pin 1 and is grounded to the TS–712 test set chassis through the POWER switch when the switch is in the ON position. Resistor R21 is a voltage-dropping variable resistor used to adjust the A voltage to the correct operating level. The A voltage is connected directly to pin 7 of tubes V1 and V2.

(2) The A voltage is measured by meter M1 when the MEASURE switch is in the A BAT position (par. 87).

b. B-Battery Power Supply Circuit.

(1) Figure 43 shows the B-battery power supply circuit. Positive 90 volts is delivered to the TS–712 test set through pin 5 of connector P3. The negative side of the battery is connected to pin 1 and is grounded to the TS–712 test set chassis when the POWER switch is in the ON position. Resistor R22 is a voltage-dropping variable resistor used to adjust the B voltage to the correct operating level (BAT mark on the M1 scale). The B battery is connected to the plate of amplifier V1 through plate load resistor R10 and to the plate of second amplifier V2 through the primary of transformer T1. The screen grids of both tubes connect directly to the B voltage. Capacitor C10 prevents the signal voltage variations from developing across the internal resistance of the B battery.

(2) Resistors R15 and R16 form a voltage divider across the B battery and they enable meter M1 to measure the B-battery voltage indirectly by reading the voltage drop across R16. This test is made in the B BAT position of the MEASURE switch (par. 88).

86. Repeater AN/TCC–11 Voltage Test, REP VOLTS

(fig. 16—See foldin in back of Manual)

The AN/TCC–11 voltage test measures the d-c voltage of the repeater by placing meter M1 and series-multiplying resistor R17 across resistor R19 of the repeater B-voltage divider consisting of resistors R1, R18, R19, and R20. Resistor R1 is located in the AN/TCC–11; resistors R18, R19, and R20 are in the TS–712 test set. The TS–712 test set connection to resistor R1 is made through pin H of connector P1. The return back to the AN/TCC–11 is made through pin M of connector P1. The voltage divider therefore is always in parallel with the power circuit of the repeater while the TS–712 test set is connected to the AN/TCC–11 repeater. Meter M1 and resistor R17 are connected across resistor R19 of the voltage divider through the four sections of the MEASURE switch (in the REP VOLTS position) and the POWER switch (in the ON position). Under normal conditions, the meter reading for the repeater voltage test is at the BAT meter-scale marking.

87. Telephone Test Set TS–712/TCC–11 A-Battery Voltage Test Circuit

(fig. 43)

The TS–712 test set filament voltage test is made by inserting meter M1 with series-multiplying resistor R13 across the filament load of the transmission test amplifiers. Meter M1 and series-multiplying resistor R13 are connected across the filament load through sections 3 and 4 of the MEASURE switch (in the A BAT position) and through the POWER switch (in the ON position). Under normal conditions, the meter reading for the A-battery voltage test is at BAT mark on the scale, thus adjusting the filament voltage to 1.2 volts.

88. Telephone Test Set TS–712/TCC–11 B-Battery Voltage Test Circuit

(fig. 43)

The TS–712 test set B-voltage test is made by inserting meter M1 connected with series-multiplying resistor R14 across resistor R16 of the voltage divider consisting of resistors R16, R15, and R22. Meter M1 and resistor R14 are connected across resistor R16 of the voltage divider through sections 3 and 4 of the MEASURE switch (in the B BAT position), and through the POWER switch (in the ON position). Under normal conditions, the meter reading for the B-battery voltage test is at BAT mark on the scale. This adjustment provides a plate and screen supply voltage of 67 volts.

89. Repeater Vacuum-Tube Activity Test

(figs. 17—See foldin in back of Manual—41, 42, 43)

The repeater vacuum-tube activity test provides an indication of the amount of space current in the AN/TCC–11 repeater line amplifier tubes when current through the heaters of the tubes is diminished slightly. The test involves two steps: First the meter is connected through MEASURE switch S3 to one of the repeater amplifier tubes to obtain a meter indication of the tubes' space current; secondly, V ACT switch S7 is turned to TEST, and the heater current of all the amplifying tubes is lowered and the meter deflection drops. If the tube being tested has low emission and is in need of replacement, after approximately 1 minute of low heater current, the meter indication will be more than 3-db scale markings below the space current reading before the heater current was diminished. The connections of the meter to the four amplifying tubes for space current measurement is described in paragraphs 90 through 93. Paragraph 94 describes the manner in which the V ACT switch alters the amplifier heater current.

90. Space Current Measurement of V1 in Line Amplifier AR1, MEASURE Switch Position V1 AMP 1

(figs. 17, 41, 42, 43)

Meter M1 is connected to measure the space current of the first stage in repeater line amplifier AR1 (fig. 41), when the MEASURE switch is in the V1 AMP 1 position. To avoid breaking the circuit of the operating amplifier in order to insert the meter in series with the cathode for this measurement, the meter is connected from the cathode (+18 volts) to the control-grid voltage source (+16 volts). The meter therefore indicates the difference of potential between the cathode and the grid voltage. The grid bias voltage is applied to the TS–712 test set through pin J of TS–712 test set connector P1 (fig. 43). The cathode potential is applied to the TS–712 test set through pin B of the same connector. Within the test set, the meter is connected from pin J to pin B of connector P1 through the MEASURE switch and through the POWER switch. At the cathode of V1 in the repeater (figs. 17, 41, 42), the two-section filter network consisting of R5 and C5, R3 and C3 bypasses signal voltage variations that otherwise would enter the space current measuring circuit. In the test set, the meter is connected between pins P and B of connector P1 through the MEASURE switch and through the POWER switch.

91. Space Current Measurement of V2 in Line Amplifier AR1, MEASURE Switch Position V2 AMP 1

(figs. 17, 41, 42, 43)

Meter M1 is connected to measure the space current of the second stage in the repeater line amplifier AR1 when the MEASURE switch is operated to the V2 AMP 1 position. The circuit is the same as described in paragraph 90, except that the signal voltage filter at the cathode of V2 consists of resistor R9 and capacitor C9 and that the cathode potential enters the TS–712 test set through pin K of connector P1 (fig. 43).

92. Space Current Measurement of V1 in Line Amplifier AR2, MEASURE Switch Position V1 AMP 2

(figs. 17, 41, 42, 43)

Meter M1 is connected to measure the space current of the first stage in line amplifier AR2 by operating the MEASURE switch to the V1 AMP 2 position. The circuit is the same as that described in paragraph 90, except that the cathode potential enters the TS–712 test set through pin F of connector P1.

93. Space Current Measurement of V2 in Line Amplifier AR2, MEASURE Switch Position V2 AMP 2

(figs. 17, 41, 42, 43)

Meter M1 is connected to measure the space current of the second stage in line amplifier AR2

by operating the MEASURE switch to the V2 AMP 2 position. The circuit is the same as described in paragraph 90, except that the signal voltage filter at the cathode consists of resistor R9 and capacitor C9 and the cathode potential enters the TS–712 test set through pin K of connector P1.

94. Repeater Filament-Current Shunt through V ACT Switch S7

(figs. 17, 41, 42, 43)

a. When the TS–712 test set is connected to the AN/TCC–11 repeater an additional high-resistance circuit is placed in parallel with the power circuit of the repeater. The high-resistance circuit consists of resistor R1 of the AN/TCC–11 (fig. 17), and TS–712 test set resistors R18, R19, and R20 (fig. 17). The positive repeater voltage is dropped first across resistor R1. The low-voltage end of resistor R1 is connected into the TS–712 test set through pin H of connector P1. Resistors R18, R19, and R20 in the TS–712 test set divide the rest of the repeater voltage. The return to the negative side of the repeater chassis is made through pin M of connector P1 to chassis ground of the repeater filter section.

b. When operated to the TEST position, V ACT Switch S7 connects pins H and M of the test set. This connection places resistor R1 across the AN/TCC–11 repeater power circuit. The effect is to reduce the voltage across the AN/TCC–11 repeater and the heaters of the tubes in the repeater line amplifiers. Lowering of the heater voltage lowers the heater current and causes the space current deflection on the meter to back off more than 3-db scale markings if the tube is unsatisfactory. A tube with weak cathode emission introduces distortion in the amplification of signal frequencies and must be replaced.

Section III. ORDER-WIRE CIRCUIT

95. Order-Wire Circuit, Description

(figs. 42, 43)

a. When the TS–712 test set is connected to an AN/TCC–11 repeater, the high-impedance order-wire circuit of the TS–712 test set is bridged across the order wire of each transmission pair of the carrier communication system. The high impedance is provided by attenuator pads selected by OW GAIN switch S6. These pads prevent the voice frequencies from *singing* through the order-wire loops between the unattended AN/TCC–11 repeater and the attended point. The pads are described in paragraphs 104 through 107.

b. Bridging the order-wire circuit of the TS–712 test set across the AN/TCC–11 repeater order-wire circuit places the test-set ringing and talking signals on all four transmission pairs of the spiral-four cables in both directions from the repeater at the same time. However, these signals can be received only on the receiving pair at the attended points. Only the unattended-repeater order-wire signal sent over the pair in which the direction of transmission is the same as that of the order-wire signal produces a useful order-wire ringing and voice signal at the attended point. The order-wire voice signal from the attended point travels over and reaches the AN/TCC–11 repeater over the transmission pair in which the direction of transmission is from the attended point to the unattended AN/TCC–11 repeater.

c. The unattended AN/TCC–11 repeater contains no order-wire amplifiers. The order-wire output of the TS–712 test set therefore faces line attenuation in both directions of transmission from the repeater until an attended location (and amplification) is reached. The attenuators controlled by the OW GAIN switch presents the least loss in the direction of the attended location (AN/TCC–7 or AN/TCC–8) supplying power to the unattended AN/TCC–11 repeater. This attended location always can be reached. Once the ringing or talking output of the TS–712 test set reaches the order-wire amplifier of the attended location and is amplified, it continues in the same direction along the length of the telephone carrier system.

96. Ringing and Talking, Description

(figs. 8, 43)

a. Telephone EE–8–( ) connects to TS–712 test set binding post L1 and L2. Telephone EE–8–( ) has a handset for listening and talking, and a hand generator which is operated to supply voltage to the ringing-signal circuit of the TS–712 test set. The output of the hand generator is delivered to 1,600-cycle ringing oscillator Q1 through the ORDER WIRE switch when the switch is in the RING position (fig. 43). The same position of the switch connects the output of the oscillator to transformer T3. The handset of Telephone EE–

8–( ) is connected to transformer T3 through the TALK position of the ORDER WIRE switch. The secondary of transformer T3 is connected to the order-wire circuits in the AN/TCC–11 repeater through OW GAIN switch S6 and connector P1.

97. Low-Frequency Ringing-Voltage Limiter, Varistor CR5

(fig. 43)

For an average cranking speed of 200 rpm, the hand generator in Telephone EE–8–( ) supplies approximately 65 volts at 16 cps for powering the 1,600-cycle ringing oscillator. This voltage is limited to approximately 45 volts in the TS–712 test set by a voltage-limiting network consisting of resistor R32 and varistor CR5. Varistor CR5 changes resistance as the amount of voltage developed across CR5 changes. If the applied voltage increases, the varistor resistance decreases and maintains a drop of approximately 45 volts. The rest of the applied voltage appears across R32. The 45-volt amplitude appearing across the varistor is impressed on the low-frequency ringing voltage rectifier made up of crystal rectifiers CR1, CR2, CR3, and CR4.

98. Low-Frequency Ringing-Voltage Rectifier CR1, CR2, CR3, and CR4

(fig. 43)

The 16-cycle output of Telephone EE–8–( ) is rectified in the bridge rectifier consisting of varistors CR1, CR2, CR3, and CR4. The 32-cycle ripple-frequency output is filtered by the resistor-capacitor network consisting of resistors R29 and R31, and capacitors C16 through C24. The filtered d-c voltage appears across bleeder resistor R28. This voltage is impressed between the base and the collector of transistor Q1 of the 1,600-cycle ringing oscillator.

99. Ringing Oscillator Q1, 1,600 Cycles

(fig. 43)

The d-c voltage from the rectifier (par. 98) is applied to transistor Q1 in such a way as to establish a proper d-c operating point (par. 102). Resistors R29, R30, and R31 are arranged to provide the proper d-c bias for the emitter. Capacitor C22 filters the emitter d-c voltage. Current flows in the collector branch of the transistor through the tuned circuit consisting of the 3–5 winding of transformer T2, capacitors C11, C15, and, optionally, C12, C13, and C14. This circuit is tuned to a frequency of 1,600 cps. Oscillations at 1,600 cps are set up in the tuned circuit, and an induced output voltage appears across terminals 1 and 2 of transformer T2. A portion of the collector output power is fed back to the emitter through current-limiting resistor R26, so that the oscillations are sustained. Resistor R27 is common to the collector-base and emitter-base circuits and provides additional feedback voltage for oscillation. Output power passes through an attenuator consisting of resistors R23, R24, and R25, through transformer T3 and to the order-wire line circuits through terminals L and M, and N and M of connector P1.

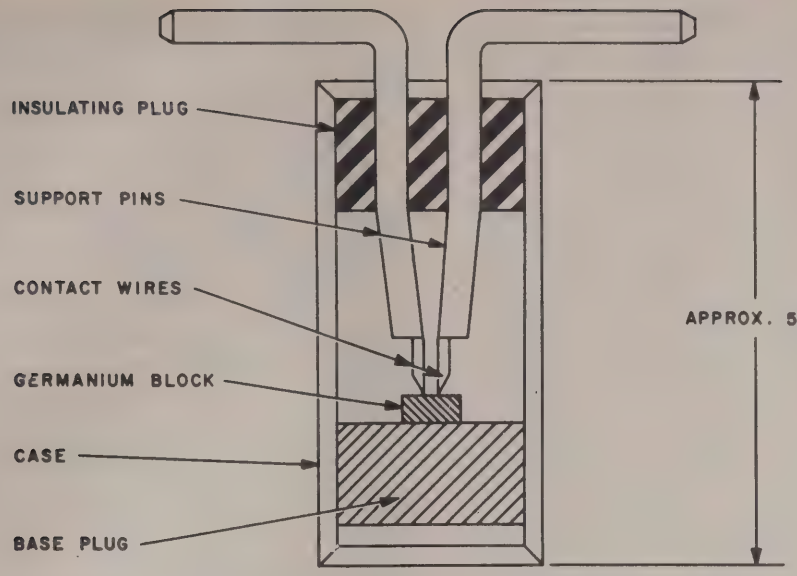
100. Transistors, Advantages and Use

a. Transistor is the name given to a semiconductor electronic device which may supplement or replace the vacuum tube in many applications. A transistor differs advantageously from a vacuum tube in several important respects. It has no filament; consequently it consumes no filament power and requires no warmup time. It is both smaller and lighter than any commercially available vacuum tube. Within the present limitations of their power handling capacity, noise, and frequency response, transistors can perform many of the tasks now performed by vacuum tubes. They have been demonstrated successfully in radio-frequency, intermediate-frequency, and audio-frequency amplifiers, oscillators, mixers, and pulse generators.

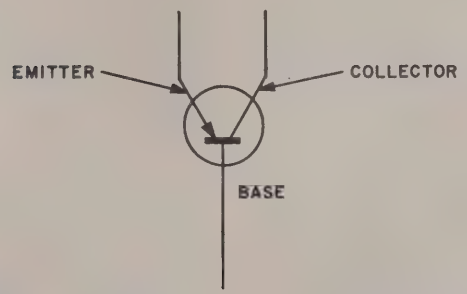
b. Transistor Q1 used in the TS–712 test set is a point-contact transistor. It consists of a small wafer of the semiconductor germanium, onto one surface of which two point contacts are made, side by side and close together. These contacts, with their immediate electrical connections, are called the *emitter* and the *collector*. A large area contact to the body of the germanium also is made and called the *base* connection, or simply, the *base*. A, figure 18 shows a longitudinal sectional drawing of a point contact transistor, and B, figure 18 shows the conventional schematic representation.

101. Transistor Theory

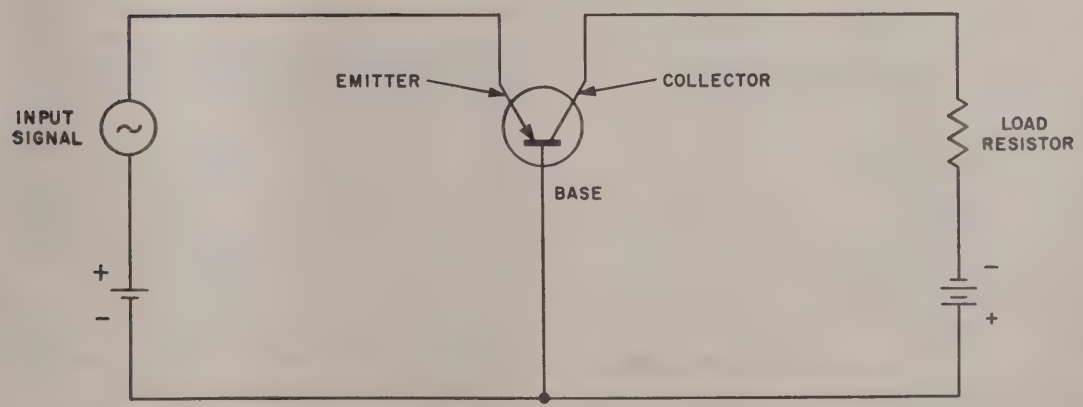
a. Semiconductors. To explain the action of transistors, it is necessary to deal briefly with the subject of semiconductors. Semiconductors, as the name implies, are materials which are neither conductors nor insulators, but which have conductivities somewhere between the conductivities on good conductors and good insulators. A good



SECTION DRAWING OF A POINT-CONTACT TRANSISTOR A



SCHEMATIC CIRCUIT SYMBOL FOR A TRANSISTOR B



SIMPLIFIED TRANSISTOR AMPLIFIER CIRCUIT C

TM 2143-34

Figure 18. Point contact transistor, transistor schematic symbol, and simplified transistor amplification circuit.

conducting material is characterized as having a large number of electrons which are relatively loosely bound within the atomic structure of the material. These electrons are free to move along the material in response to a mild external force and, by moving, create current flow. A nonconducting or insulating material contains many electrons, but the electrons in an atom are held tightly in place with respect to other atoms of the material and are not free to move about. A semiconductor contains some tightly bound electrons and a few electrons which are free to move about.

b. Pure Germanium. There are many materials which are semiconductors, but presently the most important material is germanium. This is the only semiconducting material that will be discussed here. The germanium crystal is composed of millions of germanium atoms, each consisting of a positively charged nucleus and a number of negatively charged electrons. All but four of the electrons are bound tightly to the nucleus. The remaining four electrons, which may combine in some manner with atoms of other substances, are called *valence* electrons. In a pure germanium crystal, however, the valence electrons of one atom form what are known as *electron-pair bonds* with electrons of adjacent atoms. This means that the atoms are arranged in such a way that the valence electrons are fixed in place and contribute only slightly to the conductivity of the crystal. Figure 19 shows a representation of a crystal of pure germanium together with an illustration showing the *jeep in a two-story garage* analogy, sometimes used to clarify certain concepts relating to semiconductor action. The circles

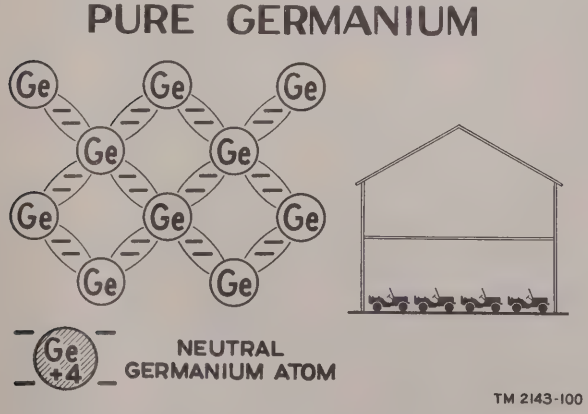


Figure 19. Diagrammatic representation of a pure germanium crystal showing electron-pair bonds, a germanium atom with its valence electrons, and the garage analogy.

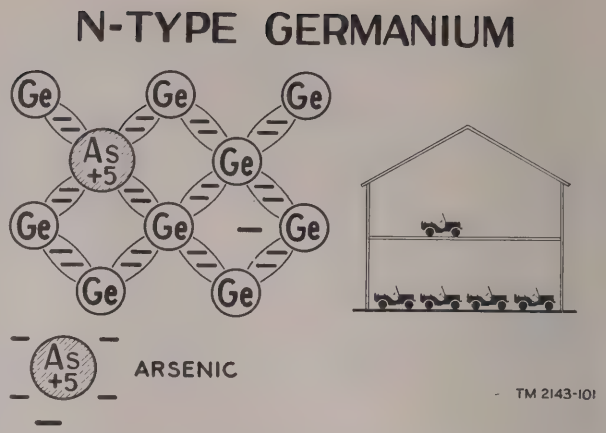


Figure 20. Diagrammatic representation of a germanium crystal containing an N-type impurity (produces an excess electron), the atom of arsenic with its valence electrons, and the garage analogy.

labeled *Ge* represent germanium atoms. The heavy dashes, or minus signs, represent valence electrons. Each pair of lines connecting two germanium atoms and including two valence electrons represents an electron-pair bond. Note that in the jeep analogy, the jeeps are packed tightly in the garage and cannot be moved from one side to the other. This is analogous to the low-conducting property of pure germanium.

c. N-Type Germanium. The normal conductivity of pure germanium must be increased to obtain transistor action. This is done by adding small amounts of certain types of impurities to the crystal. Figure 20 shows how one type of impurity can add conduction electrons to the crystal. If an impurity such as arsenic, having five valence electrons, is introduced into the crystal, each impurity atom takes the place of one germanium atom and four of the five valence electrons from electron-pair bonds with the adjacent germanium atoms. The fifth electron, however, is free to wander about the crystal, and contribute to the conductivity. In the jeep analogy, this is similar to inserting a jeep in the top story of the garage. This jeep is free to move from one side of the garage to the other. Impurities which donate electrons to the crystal are called *donor* or *N-type* impurities; germanium containing a large number of such impurity atoms is called *N-type germanium.*

d. P-Type Germanium. Conduction in germanium also may be increased by adding a second type of impurity, such as boron. Figure 21 illustrates how this impurity, known as an *acceptor or P-type* impurity, causes a deficiency of electrons.

If an impurity having three valence electrons per atom is added, each impurity atom takes the place of a germanium atom, and its three valence electrons form bonds with electrons of adjacent germanium atoms. Then, in order to fit completely into the structure of the crystal, the impurity atom borrows an electron from an electron-pair bond from somewhere else in the crystal and leaves a *hole*, or a net positive charge in the place formerly occupied by the borrowed electron. Holes contribute to the conductivity of germanium in much the same manner as electrons, because the holes can move from atom to atom. Note that this corresponds in the jeep analogy to removing a jeep from the lower floor. The space the removed jeep occupied can be moved from one side to the other. Germanium containing a large number of P-type impurity atoms is known as *P-type germanium*. It is important to grasp the concept of *hole current*, because it is a fundamental principle of semiconductors that current in a semiconductor can be carried by electrons and by holes. Figure 22 shows how electrons are attracted to a region of positive charge, and how holes are attracted to a region of negative charge. In a semiconductor figure 22 shows the two types of current that can occur.

e. Barriers. Before the operation of the transistor in a specific circuit is discussed, it is important to mention the current rectification obtained when a metal *point* electrode makes contact with the germanium crystal surface. When such a point contact is made, a *barrier* to the flow of current will be present or absent, depending upon the polarity of the voltage applied between the metal point and the germanium crystal. For instance, when a metal point contacts the surface of N-type germanium, the barrier will be absent and a large forward current will flow if the metal point is biased positively with respect to the crystal. Such a bias voltage often is referred to as a bias *in the forward direction*. Bias of the opposite polarity is spoken of as bias *in the reverse direction*. This barrier consists of a very thin layer at the surface of the crystal which, when subjected to voltage of the porper polarity, becomes an insulating layer. That is, fewer current carriers are present in this thin surface layer than are present in the interior of the crystal. The importance of this barrier is indicated in paragraph 102*b*.

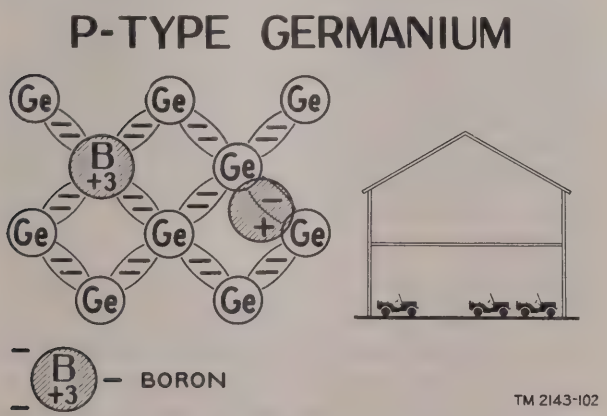


Figure 21. Diagrammatic representation of a germanium crystal containing a P-type impurity (produces a hole); the atom of boron with its valence electrons, and the garage analogy.

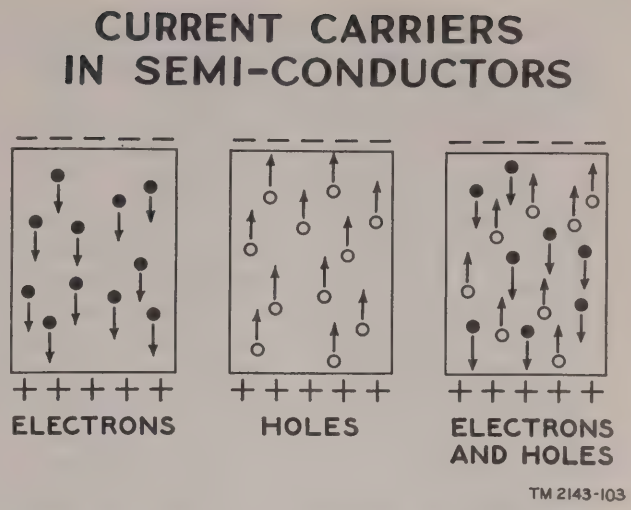


Figure 22. Diagrammatic representation of flow of current carriers (holes and electrons) in germanium crystals with external voltages applied.

102. Transistor Amplification and Oscillation (fig. 18)

a. A diagram of a transistor amplifier circuit utilizing a point-contact transistor of N-type germanium is shown in C, figure 18. The collector is biased negatively (in the reverse direction) with relation to the base or germanium slab. A small current (about .5 milliampere) will flow in the collector circuit if a voltage of about −25 volts is applied to the collector contact. If a positive voltage is applied to the emitter contact, electrons will enter the emitter, and a flow of holes from the region near the emitter will be attracted to the negative terminal of the collector battery, thereby increasing the collector current appreciably. With both the emitter and collector drawing current, a small signal voltage is applied to the transistor as

indicated in the circuit diagram. As the applied voltage swings positive, the emitter current will increase, thereby increasing the collector current by supplying additional holes. During the negative swing of the signal voltage, the emitter current (and the collector current) will decrease. If the assumption is made that every unit of hole current which leaves the emitter reaches the collector, it follows that a small change in emitter current will result in an equivalent change in collector current, producing *current amplification* of one. The current amplification factor (called *alpha*) is defined as the ratio of a change in collector current to a change in emitter current when the collector voltage is held constant. A very significant characteristic of the transistor, however, is that alpha may be 2 or greater. One explanation of this phenomenon is that a space charge of holes is formed about the collector point. It appears that this positive charge increases the electron flow from the *collector* to the germanium and accounts for the current amplification.

b. The transistor can amplify not only input current, but power as well. Because the emitter is biased in the forward direction, only a small impedance to the flow of current exists; therefore the input impedance of the transistor is fairly low (approximately 500 ohms). The collector, on the other hand, is biased in the reverse direction and offers a high impedance to the flow of current. The collector resistance comprises the greatest portion of the output impedance of the transistor. The load resistance, to provide a proper impedance match, must be fairly high (approximately 10,000 to 20,000 ohms). Since the input and the output signal is applied to the transistor at a low impedance and the output is taken from a high impedance, power amplification is obtained, even though alpha may be approximately 1.

c. In the TS–712 test set (fig. 43) transistor Q1 is used as an oscillator by feeding a portion of the output signal from the collector lead back into the emitter in such a way as to sustain oscillations. In this case the collector load is the tuned circuit of the primary of transformer T2 and capacitors C11, and C15, and when required, for the proper frequency C12, C13, and C14.

103. Ring-Talk Transformer T3

(figs. 42, 43)

The 1,600–cycle voltage output of the transistor oscillator passes to terminals 1 and 3 of transformer T3 through the RING position of ORDER WIRE switch S5 (fig. 43). The voice signal output of Telephone EE–8–( ) passes to the same terminals through the TALK position of the ORDER WIRE switch. These signals are coupled inductively to the winding from terminal 4 to terminal 5 and the winding from terminal 5 to terminal 6. The signal appearing across the secondary winding (terminals 4 and 5) is connected to the repeater order-wire circuit from the J1 to J2 end and the secondary winding (terminals 5 and 6) is connected to the repeater order-wire circuit from the J2 to the J1 end. Resistor R33 is a balancing resistor for transformer T3, and is arranged to provide a large loss between the J1 to J2 direction and the J2 to J1 direction of the repeater order-wire circuits.

104. OW GAIN Switch S6

(fig. 43)

Ringing and voice signals from Telephone EE–8–( ) are applied to the primary of transformer T3 (terminals 1, 3) through ORDER WIRE switch S5 when the switch is in the RING and TALK positions, respectively. These signals appear across the secondary (terminals 4, 5, 6) of T3 (fig. 43). The center tap (terminal 5) of the secondary is connected through resistor R33, and pin M of connector P1 to the AN/TCC–11 panel ground, which is also the ground side of the J1–J2 direction and J2–J1 direction order-wire circuits of the AN/TCC–11 repeater (fig. 42). The resistor networks associated with the OW GAIN switch provide an adjustable loss in the transmission paths which bridge the J1–J2 and J2–J1 repeater order-wire circuits.

a. The local ringing or talking voltage from terminal 6 of transformer T3 (fig. 43) to ground is applied, through the network controlled by operation of the OW GAIN switch, through blocking capacitor C3, through pin L of connector P1, to the J1–J2 direction order-wire circuit of the AN/TCC–11 repeater (fig. 42). Capacitor C8 places pin M of connector P1 at a-c ground potential.

(1) This signal travels over the spiral-four cable in the J1–J2 direction, away from the attended point which supplies power to the repeater. The attenuation introduced by the added cables in that direction makes the possibility of communication there unreliable and consequently, not used normally.

(2) The voice signal from the attended point which supplies power to the AN/TCC–11 repeater is received from the attended point in the J1–J2 direction through terminals L and M of TS–712 test set connector P1, terminals 6 and 5 of transformer T3, and it reaches the Telephone EE–8–( ) receiver through the secondary of transformer T3 (terminals 1, 3) and ORDER WIRE switch S5.

b. The local ringing or talking voltage from terminal 4 of transformer T3 to ground is applied, through the network controlled by the OW GAIN switch, through blocking capacitor C4, and through pin N of connector P1 to the J2–J1 direction order-wire circuit of the AN/TCC–11 repeater (fig. 43).

(1) This local signal travels over the spiral-four cable in the J2–J1 direction to the attended point, where it operates the ringer, or the handset receiver.

(2) If the lineman is able to communicate with the attended point in the (J1–J2) direction away from the point supplying power, the talking signals from this point will reach the Telephone EE–8–( ) receiver through terminals 5 and 4 of transformer T3.

c. The LOW, MEDIUM, and HIGH positions of the OW GAIN switch are described in paragraphs 105, 106, and 107 respectively. The proper position of the switch is determined by the position of the AN/TCC–11 repeater in the power loop.

105. OW GAIN Switch S6, LOW Position
(fig. 43)

The LOW position of the OW GAIN switch normally is used for ringing and talking from an AN/TCC–11 repeater which is two repeaters removed from the power-looping point.

a. In the LOW position, the OW GAIN switch connects speech input from the J1–J2 direction repeater order-wire circuit (fig. 42) to pin L of connector P1, through capacitor C3, and through a pad made up of resistors R34 and R35 to terminal 6 of transformer T3 (fig. 43).

b. In the LOW position, the OW GAIN switch also connects the ring-talk output from terminal 4 of transformer T3, through a pad made up of resistors R40, R41, and R46, through capacitor C4, through pin N of connector P1 to the J2–J1 direction repeater order-wire circuit.

106. OW GAIN Switch S6, MEDIUM Position
(fig. 43)

The MEDIUM position of the OW GAIN switch normally is used for ringing and talking from an AN/TCC–11 repeater which is one repeater removed from the power-looping point. The ringing and talking signals are sent from and brought to transformer T3 through the OW GAIN switch circuits as described in paragraph 105, except that the resistance pads employ different resistors. Speech received from the attended point passes through a pad consisting of resistors R36 and R37. Ringing and speech signals from transformer T3 pass through a pad consisting of resistors R42, R43, and R45.

107. OW GAIN Switch S6, HIGH Position
(fig. 43)

The HIGH position of the OW GAIN switch normally is used for ringing and talking from an AN/TCC–11 repeater at the power-looping point. The ringing and talking signals are sent from and brought to transformer T3 through the OW GAIN switch circuits as described in paragraph 105, except that the resistance pads employ different resistors. Speech received from the attended point passes through attenuating resistor R38. Ringing and speech signals from transformer T3 pass through a pad consisting of resistors R39 and R44.

Section IV. THEORY OF ARTIFICIAL CABLE

108. Artificial Cable Z1, Use

To test an AN/TCC–11 repeater at an attended point, the J1 end of the AN/TCC–11 repeater is connected to the spiral-four cable from an attended point (AN/TCC–7 or AN/TCC–8). The spiral-four connector of the artificial cable is inserted into connector J2 on the AN/TCC–11 repeater. The test signals from the attended equipment are sent through AN/TCC–11 line amplifier AR1 circuits, into the artificial cable, and back through line amplifier AR2 circuits to the attended equipment for measurement on the test panel of that equipment.

a. The artificial cable simulates the transmission losses of 5¾ miles of spiral-four cable, over a frequency range of 12 kc to 68 kc. The attenuation introduced by the artificial cable at voice frequencies is sufficient to prevent *singing* through the direct loop-back connection of the order-wire path.

b. The artificial cable also provides a low-resistance d-c path through which the circuits of the AN/TCC–11 repeater are energized by Power Supply PP–826/U which is located at, and is a part of, the attended equipment.

c. The artificial cable consists of line-matching transformer (Z1) T1 (par. 109), cable-simulating network (Z1) Z1 (par. 110), and line-matching transformer (Z1) T2 (par. 109).

109. Artificial Cable, Line-Matching Transformers

(fig. 23)

a. When the artificial cable is connected to the AN/TCC–11 repeater, the test signal from the attended equipment is amplified by line amplifier AR1 in the repeater (fig. 41), and leaves the repeater through the female contacts of connector J2 (fig. 42). The signal enters the male contacts of the artificial cable spiral-four connector and is applied to the primary of line-matching transformer (Z1) T2. The impedance of the primary is 135 ohms, and it matches the impedance of the transmission pair of the spiral-four cable.

b. From the center of the (Z1) T1 primary (terminal 2 or 3), a direct connection is made to the center terminals (2 or 3) of (Z1) T2 to form a through path for the .1-ampere current from Power Supply PP–826/U back through the AN/TCC–11 repeater.

c. The output of (Z1) T2 secondary is applied to terminals 3 and 4 of cable-simulating network (Z1) Z1 (par. 110).

d. From cable-simulating network Z1 the signals are applied to the primary (terminals 5 and 6) of line-matching transformer (Z1) T1. The secondary of line-matching transformer (Z1) T1 has an impedance of 135 ohms, and matches the characteristic impedance of the spiral-four cable pair to which the signals are applied. The output of the secondary is applied to the female terminals of artificial cable spiral-four connector (Z1) P1, and is passed on to the male terminals of the J2 spiral-four connector of the AN/TCC–11 repeater.

110. Artificial Cable, Network (Z1) Z1

Cable-simulating network (Z1) Z1 is composed of resistors, capacitors, and inductors. This circuit simulates the transmission loss of 5¾ miles of spiral-four cable. The output is taken from network terminals 1 and 2 and applied to the input winding (terminals 5 and 6) of line-matching transformer (Z1) T1 (par. 109*d*). Resistor (Z1) R1 is shunted across network (Z1) Z1 to control the network loss at voice frequencies for tests of the order-wire circuit.

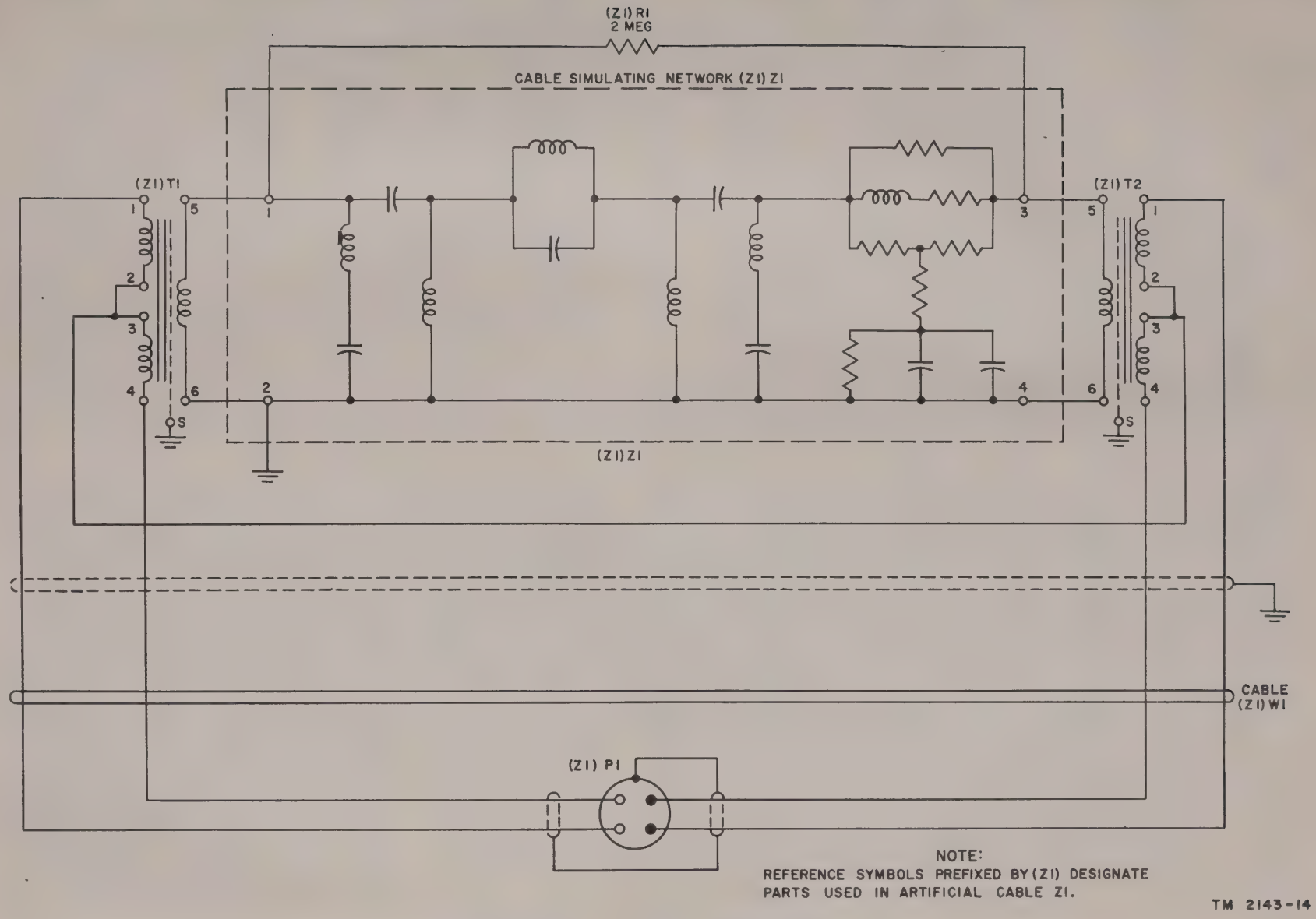


Figure 23. Artificial cable Z1, schematic diagram.

CHAPTER 6
FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and the skill of the repairman.

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

111. Troubleshooting Procedures

Servicing a defective TS–712 test set requires localization of the faulty part. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by making voltage and resistance measurements. The tests listed below aid in isolating the source of trouble. Remember that the servicing procedure should cause no further damage to the equipment. First, trouble should be localized to a single stage or circuit. Then, the trouble may be isolated to a part within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

a. Visual Inspection. The purpose of visual inspection is to locate any visible trouble. Through this inspection alone, the repairman may frequently discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the equipment that may occur through improper servicing methods, and in preventing future failures.

b. Checking Key Circuits for Shorts. The B+ and filament-supply circuits should be checked for possible shorts before the equipment is tested with power applied. These checks prevent further damage to the equipment from possible short circuits.

c. Troubleshooting Chart. The trouble symptoms listed in this chart (par. 117) will aid greatly in localizing trouble.

d. Signal Substitution. The principal advantage of the signal substitution method is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests. The signal substitution tests for the TS–712 test set are outlined in paragraph 131.

e. Stage Gain Information. This information is included in the troubleshooting (par. 117) and the signal substitution (par. 131) tests.

f. Intermittents. If present, this type of trouble often may be made to appear by tapping or jarring the suspected part. It is possible that the trouble is not in the equipment itself but may be due to external conditions. In this event, check the external connections.

112. Troubleshooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the troubleshooting data in the table below.

Fig. No.	Par. No.	Description
43	----	Telephone Test Set TS–712/TCC–11, schematic diagram.
28	----	Telephone Test Set TS–712/TCC–11, SELECTOR switch S1, wiring diagram.
29	----	Telephone Test Set TS–712/TCC–11, MEASURE switch S3, wiring diagram.
30	----	Telephone Test Set TS–712/TCC–11, OW GAIN switch S6, wiring diagram.
31	----	Telephone Test Set TS–712/TCC–11, tube-socket and resistor-board voltage and resistance diagram.
32	----	Telephone Test Set TS–712/TCC–11, side view of chassis showing GAIN control.
33	----	Telephone Test Set TS–712/TCC–11, left end view of chassis with battery bracket and battery removed.
34	----	Telephone Test Set TS–712/TCC–11, bottom chassis swung out, showing rear of top panel, battery bracket and battery removed.
35	----	Telephone Test Set TS–712/TCC–11, bottom chassis swung out, showing top of bottom chassis.
3	----	Telephone Test Set TS–712/TCC–11, top panel view.
23	----	Artificial cable Z1, schematic diagram.
44	----	Telephone Test Set TS–712/TCC–11 and artificial cable Z1, wiring diagram.
	125	D-c resistance of transformers.
	118	Additional troubleshooting information.

113. Tools and Test Equipment Required for Troubleshooting and Testing

The tools and test equipment required for troubleshooting and testing Telephone Test Set TS–712/TCC–11 are listed below. The technical manuals associated with the test equipment also are listed where applicable.

Test equipment	Technical manual	No. reqd.
Attenuator TS–402/U or equal.	TM 11–2044	1
Analyzer ZM–3/U or equal	TM 11–5043	1
Clips, alligator		2
Electronic Multimeter ME–6A/U or equal.	TM 11–5549	1
Telephone EE–8–( )	TM 11–333	1
Frequency Meter FR–67/U or equal.	TM 11–2698	1
Power supply, adjustable, 135–160 v dc, .002 amp.		1
Resistor, 135 ohms ±1%, ½ w, Sig C stock No. 3Z6013E5–6.		1
Resistor, 600 ohms ±1%, ½ w, Sig C stock No. 3Z6060–119.		2
Resistor, 680 ohms ±5%, ½ w, Sig C stock No. 3RC20BF681J.		1
Resistor, 2,200 ohms ±5%, ½ w, Sig C stock No. 3RC20BF222J.		2
Multimeter TS–352/U	TM 11–5527	1
Resistor, 12K ±1%, ½ w, Sig C stock No. 3Z6612–85.		1
Signal Generator SG–71/FCC or equal.		1
Supply test-cable assembly (fig. 24).		1
Telephone jack Sig C stock No. 2Z5533.		1
Telephone plug Sig C stock No. 2Z7228A–309.		1
Transformer Sig C stock No. 2Z9637.189.		1
Transmission test-cable assembly (fig. 25).		1
Tube Tester TV–7/U or equal.		1

114. General Precautions

Observe the following precautions very carefully whenever replacement of parts is required. Careless replacement of parts often makes new faults inevitable. Note the following points:

a. Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

b. Be careful not to damage other leads by pulling or by pushing them out of the way.

c. Do not allow drops of solder to fall into the chassis; they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints; a poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced, it should be replaced exactly as the original part was placed. A part with the same electrical value but different physical size may cause trouble. Give particular attention to proper grounding when replacing a part. Use the same ground as in the original wiring. Check that paired and shielded wires are correctly connected to terminals, frame ground, filament ground, or wherever specified. Failure to observe these precautions may result in improper functioning of the TS–712 test set.

Note. Signal Generator SG–71/FCC is used in the BAL position for all the tests.

115. Testing and Troubleshooting the TS–712 Test Set, General

There are no operational tests for the TS–712 test set. Tests for locating trouble are included in the troubleshooting (par. 117) and the signal substitution (par. 131) procedures. Before the troubleshooting chart can be used, the equipment must be prepared according to the instructions in paragraph 116. Test equipment required for these tests is listed in paragraph 113.

116. Troubleshooting Setup and Test Procedures

The following setup is used to prepare the TS–712 test set for the troubleshooting procedures outlined in paragraph 117:

a. Power Setup. Use the arrangement shown in A, figure 26, to supply power and terminating resistors to the TS–712 test set. This arrangement also makes the terminals of connector P1 of the TS–712 test set available as test points on the supply test-cable assembly. Power is supplied to the detector circuit of the TS–712 test set by plug-in batteries BT1 (BA–402/U) and BT2 (BA–415/U). Check to see that these batteries are connected before beginning the tests.

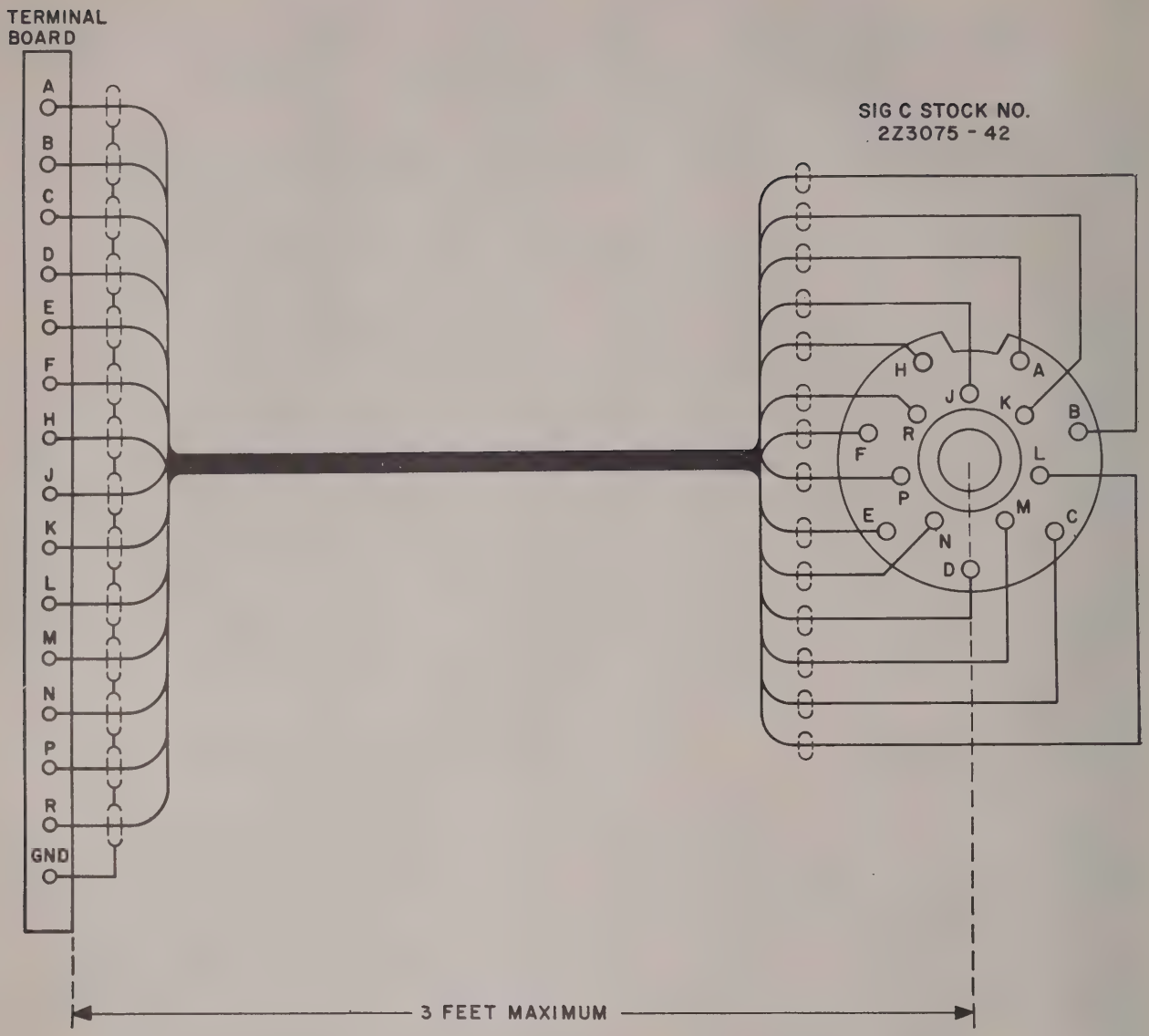


Figure 24. Supply test-cable assembly, used to test Telephone Test Set TS–712/TCC–11.

b. Test-Signal Setup for Detector Circuit. Set up the test-signal circuit as shown in B, figure 26. Follow the general instructions in (1) through (4) below to set up a test signal for tests 13 through 23 described in the troubleshooting chart (par. 117).

(1) With Frequency Meter FR–67/U (connected as shown in A, figure 26), set the SG–71/FCC frequency output within the limits required.

(2) Operate Attenuator TS–402/U at a 0-db loss. Set the output of Signal Generator SG–71/FCC at the specified voltage with Electronic Multimeter ME–6/U.

(3) Adjust the output of the test-signal arrangement to the specified frequency and voltage with no connection to the test jack. Then, operate Attenuator TS–402/U as specified in the tests.

(4) The test cord shown in figure 26 is used to apply the test signals to the equipment. Insert the test cord into the test jack and connect the test clip and the ground clip to the points specified in the troubleshooting chart.

c. Test-Signal Setup for Order-Wire Pads. Follow the procedure in (1) through (6) below for tests 26 through 31 of the troubleshooting chart (par. 117):

(1) Connect Signal Generator SG–71/FCC to a protection pad (fig. 27) consisting of two 2,200-ohm resistors and one 680-ohm resistor.

(2) Operate Signal Generator SG–71/FCC to deliver a 1-kc signal.

(3) Connect a 600-ohm resistor to Electronic Multimeter ME–6/U binding posts. Connect the A and B leads (fig. 27) to these binding posts.

(4) Operate Electronic Multimeter ME–6/U to the 1-volt range and adjust the output of the SG–71/FCC for a reading of 14 db on the ME–6/U.

(5) Disconnect the A and B leads (fig. 27) from Electronic Multimeter ME–6/U binding posts and connect the leads to binding posts L1 and L2 on the TS–712 test set.

(6) Disconnect the 600-ohm resistor from the ME–6/U binding posts.

Note. Do not readjust Signal Generator SG–71/FCC during the tests.

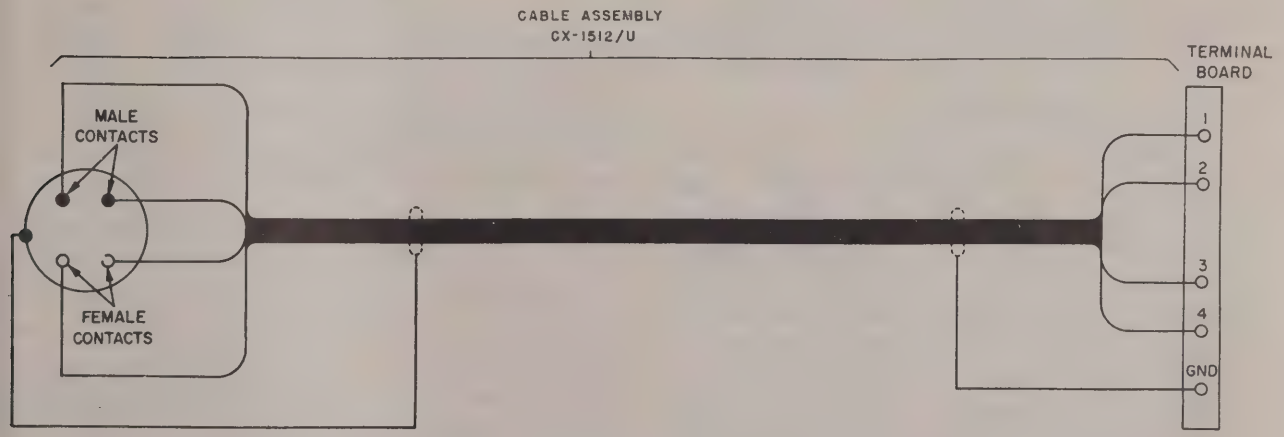
d. Battery Adjustments. To adjust voltages delivered by the A and B batteries, proceed as follows:

(1) Operate the POWER switch of the TS–712 test set to the ON position and the MEASURE switch to the A BAT position. Adjust the A BAT control until the TS–712 test set meter pointer deflects to the BAT mark.

(2) Operate the MEASURE switch to the B BAT position and adjust the B BAT control until the TS–712 test set meter pointer deflects to the BAT mark.

(3) Check these adjustments from time to time during the tests. Allow a warmup period of at least 10 minutes before making tests 13 through 23 of the troubleshooting chart (par. 117).

Note. Make all tests with the TS–712 test set removed from its carrying case. Before any tests are made with the POWER switch in the off position, check the zero adjustment of the TS–712 test set meter and adjust if necessary.



NOTES:

1. MALE CONTACTS ON THE CONNECTOR ARE WIRED TO TERMINALS 1 AND 2 OF THE TERMINAL BOARD.
2. FEMALE CONTACTS ON THE CONNECTOR ARE WIRED TO TERMINALS 3 AND 4 OF THE TERMINAL BOARD.

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Figure 25. Transmission test-cable assembly, used to test artificial cable Z1.

Figure 26 (See foldin in back of Manual)

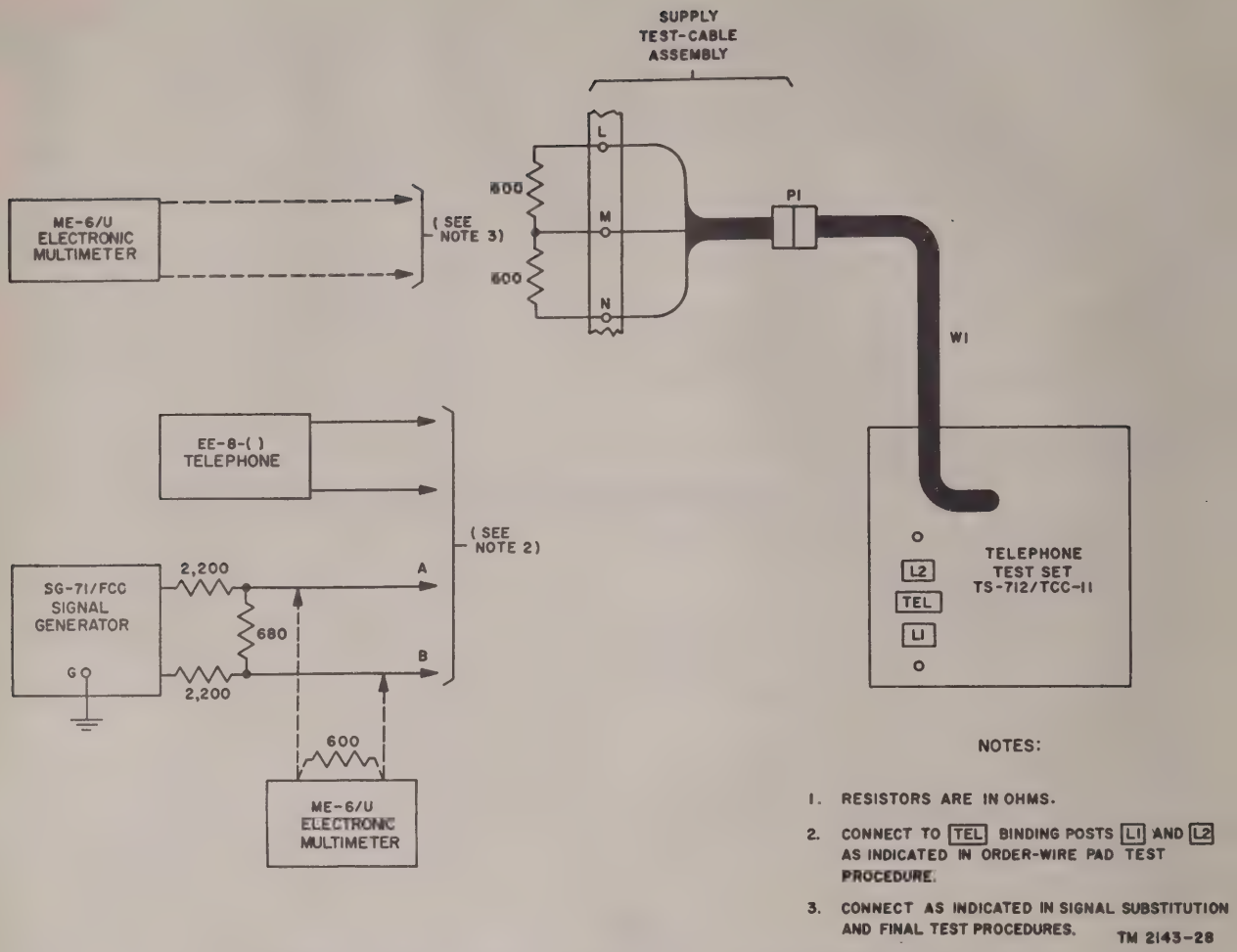


Figure 27. Telephone Test Set TS–712/TCC–11, order-wire pads test setup.

117. Troubleshooting Chart

The troubleshooting chart is provided as an aid in locating trouble in the TS–712 test set. The chart lists the symptoms that the repairman may observe while making tests. For each symptom, the probable trouble is indicated and corrective measures are given to localize the trouble and to find the faulty part. For information on how to check capacitors, resistors and other parts, see paragraphs 118 through 130. In some cases, the signal substitution procedures described in paragraph 131 and the alinement procedures described in paragraphs 139 through 144 are referred to as further aids in localizing and correcting trouble. Before any tests described in the troubleshooting chart can be performed, the troubleshooting setup and test procedures (par. 116) must be performed. Test equipment required for these tests is listed in paragraph 113. During these tests, refer to the applicable figure to locate the specified parts. Troubleshooting data for the TS–712 test set are listed in paragraph 112. Perform these tests in the sequence given.

Test	Symptom	Probable trouble	Correction
1. Operate POWER switch to ON position and MEASURE switch to A BAT position. Meter pointer should deflect.	Meter pointer does not deflect.	*a.* Defective A battery	*a.* Replace A battery.
		b. Defect between A battery and meter.	*b.* Check wiring through MEASURE switch S3 and POWER switch S4. Check resistors R21 and R73.
		c. Defective meter	*c.* Check meter (par. 128).

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
2. Adjust A BAT control for meter reading at BAT mark.	Meter cannot be adjusted to read at BAT mark.	*a.* Defective A battery *b.* Defective resistor R13 or R21. *c.* Tube V1 or V2 filament open. *d.* Defective meter	*a.* Replace A battery. *b.* Check R13 and R21. *c.* Check V1 and V2 and wiring to tube sockets XV1 and XV2. *d.* Check meter (par. 128).
Connect Multimeter TS–352/U (arranged to measure 1.2 volts dc) to terminals 1 and 7 of tubes V1 and V2. The TS–352/U reading at both tubes should be 1.2 ±1 volts.	Meter adjusts to BAT mark, but voltage as measured across terminals 1 and 7 of V1 and V2 is outside limits of 1.2 ±.1 volts dc.	*a.* Resistor R13 is defective. *b.* Defective meter	*a.* Check R13. *b.* Check meter (par. 128).
3. Operate MEASURE switch to B BAT position. Meter pointer should deflect.	Meter pointer fails to deflect.	*a.* Defective B battery *b.* Defect between B battery and meter.	*a.* Replace B battery. *b.* Check wiring through MEASURE switch S3 and POWER switch S4. Check resistors R14, R15, R16, and R22.
4. Adjust B BAT control for meter reading at BAT mark.	Meter cannot be adjusted to BAT mark.	*a.* Defective B battery *b.* Defective resistors R14, R15, R16, and R22. *c.* Defective tube V1 or V2. *d.* Defective wiring to tube sockets XV1 and XV2.	*a.* Replace B battery. *b.* Check resistors R14, R15, R16, and R22. *c.* Check V1 and V2. *d.* Check wiring through MEASURE switch S3 and POWER switch S4.
Connect Multimeter TS–352/U (arranged to measure 67 volts dc) to terminals 1 and 3 of tube V1. The TS–352/U reading should be 67 ±10 volts.	Meter can be adjusted properly to BAT mark, but voltage measured at terminals 1 and 3 of tube V1 is outside the limits of 67 ±10 volts dc.	Defective resistors R14, R15, and R16.	Check resistors R14, R15 and R16.
5. Operate MEASURE switch to REP VOLTS position. Adjust power supply (fig. 26) to deliver 150 volts to terminals H and M of supply test-cable assembly. Meter pointer should deflect.	Meter pointer does not deflect.	Defect between connector P1 and meter.	Check wiring through MEASURE switch S3. Check POWER switch S4 and resistors R17, R18, R19, and R20. Check V ACT switch S7.
6. Adjust power supply voltage until meter reads at BAT mark. Arrange the TS–352/U to measure 150 volts dc. Connect the TS–352/U to terminals H and M of supply test-cable assembly. The TS–352/U should read 148 ±15 volts.	Voltage across terminals H and M is outside limits of 148 ±15 volts.	Defective resistors R17, R18, R19, and R20.	Check resistors R17, R18, R19, and R20.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
7. Operate power supply (fig. 26) to off position. Operate V ACT switch to TEST position. Connect the TS–352/U (arranged to measure ohms) across terminals H and M of supply test-cable assembly. The TS–352/U should read 0 ohms.	Resistance across terminals H and M is not 0 ohms.	Defective V ACT switch S7.	Check V ACT switch S7 and associated wiring.
8. Disconnect wiring from positive terminal of meter. Connect the TS–352/U (arranged to measure ohms) from negative terminal of meter to terminal J of supply test-cable assembly. Operate MEASURE switch to each of following positions: V1 AMP 1; V2 AMP 1; and V2 AMP 2. The TS–352/U should read 0 ohms for each position.	Resistance from negative terminal of meter to terminal J of P1 is not 0 ohms on each position of MEASURE switch.	Defect in circuit between negative side of meter and terminal J of P1.	Check wiring through MEASURE switch S3 at the V1 AMP 1, V2 AMP 2, and V1 AMP 2 positions.
9. Reconnect wiring to terminal of positive meter and disconnect wiring from negative terminal of meter. Connect the TS–352/U from terminal B of supply test-cable assembly to positive terminal of meter. Operate MEASURE switch to following positions: V1 AMP 1; V2 AMP 1; V1 AMP 2; and V2 AMP 2. The TS–352/U should read 0 ohms for V1 AMP 1 position, and infinite resistance for each of other three positions of MEASURE switch.	Resistance from terminal B of P1 to positive meter terminal is not 0 ohms when MEASURE switch is in V1 AMP 1 position; or resistance is not infinite when MEASURE switch is in other three positions.	Defect between connector P1 and positive terminal of meter.	Check wiring through MEASURE switch S3 for V1 AMP 1, V2 AMP 1, V1 AMP 2, and V2 AMP 2 positions.
10. Connect the TS–352/U from terminal K of supply test-cable assembly to positive terminal of meter. Operate MEASURE switch to each of following positions: V1 AMP 1; V2 AMP 1; V1 AMP 2; and V2 AMP 2. The TS–352/U should read 0 ohms for V2 AMP 1 position, and infinite resistance for other three positions of MEASURE switch.	Resistance from K of P1 to positive meter terminal is not 0 ohms when MEASURE switch is in V2 AMP 1 position; or resistance is not infinite in other three positions.	Same as probable trouble 9.	Same as correction 9.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
11. Connect the TS–352/U from terminal F of supply test-cable assembly to positive terminal of meter. Operate MEASURE switch to each of following positions: V1 AMP 1; V2 AMP 1; V1 AMP 2; and V2 AMP 2. The TS–352/U should read 0 ohms for V1 AMP 2 position, and infinite resistance for other three positions of MEASURE switch.	Resistance from terminal F of P1 to positive meter terminal is not 0 ohms when MEASURE switch is in V1 AMP 2 position; or resistance is not infinite in other three positions.	Same as probable trouble 9.	Same as correction 9.
12. Connect the TS–352/U from terminal P of supply test-cable assembly to positive terminal of meter. Operate MEASURE switch to each of following positions: V1 AMP 1; V2 AMP 1; V1 AMP 2; and V2 AMP 2. The TS–352/U should read 0 ohms in V2 AMP 2 position, and infinite resistance in other three positions of MEASURE switch.	Resistance from terminal P of P1 to positive terminal of meter is not 0 ohms when MEASURE switch is in V2 AMP 2 position; or resistance is not infinite in other three positions.	Same as probable trouble 9.	Same as correction 9.
13. Reconnect wiring to negative terminal of meter. Adjust A and B batteries as outlined in paragraph 116*d*.	GAIN control cannot be adjusted for meter reading of 0 db.	Defect in circuit between terminal A of P1 and MEASURE switch S3.	Use signal substitution (par. 133) to localize trouble and find faulty part.
Operate MEASURE switch to TRANS position. Operate SELECTOR switch to AMP 1 IN 68 KC position.			
Set up test signal (par. 116*b*) as follows: Set the SG–71/FCC for 68 kc ±100 cps. Set the TS–402/U for 0-db loss. Adjust output of the SG–71/FCC until the ME–6/U reads .775 volt. Then set the TS–402/U for 23-db loss. Connect test-signal setup to terminals A and M (M is ground) of supply test-cable assembly. Adjust GAIN control until meter (M1) reads 0 db.			
14. Set the TS–402/U for 28-db loss. Meter (M1) should read −5 ±1 db.	Meter reads outside limits of −5 ±1 db.	Defective rectifier circuit.	Check V2, T1, R12, C9, and R11.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
15. Set the TS–402/U for 16-db loss. Meter (M1) should read +7 ±1 db.	Meter reads outside limits of +7 ±1 db.	Defective rectifier circuit.	Check V2, T1, R12, C9, and R11.
16. Set the TS–402/U for 23-db loss. Disconnect test-signal clip from terminal A and connect it to terminal R of supply test-cable assembly. Operate SELECTOR switch to AMP 2 IN 68 KC position. Meter (M1) should read 0±5 db.	Meter does not read within limits of 0 ±5 db.	Defect between terminal R of connector P1 and tube V1 through AMP 2 IN 68 KC contacts of SELECTOR switch S1.	Check wiring from terminal R of P1 through SELECTOR switch S1 to terminal 6 of tube V1. Check capacitor C2.
17. Operate SELECTOR switch to AMP 1 OUT 68 KC position. Disconnect test-signal clip from terminal R and connect clip to terminal C of supply test-cable assembly. Meter (M1) should read 0 ±1 db.	Meter does not read within limits of 0 ±1 db.	Defect between terminal C of P1 and tube V1 through AMP 1 OUT 68 KC contacts of switch S1.	Check wiring from terminal C of P1 through SELECTOR switch S1 to terminal 6 of tube VI. Check R1, R4, and R5.
18. Operate SELECTOR switch to AMP 2 OUT 68 KC position. Disconnect test-signal clip from terminal C and connect it to terminal E of supply test-cable assembly. Meter (M1) should read 0 ±1 db.	Meter does not read within limits of 0 ±1 db.	Defect between terminal E of P1 and tube V1 through AMP 2 OUT 68 KC contacts of switch S1.	Check wiring from terminal E of P1 through SELECTOR switch S1 to terminal 6 of tube V1. Check C6 and R3.
19. Remove test-signal clip from terminals E and M. Set up test signal (par. 116*b*) as follows: Set the SG–71/FCC to 1 kc ±20 cps. Set the TS–402/U for 0-db loss. Adjust output of the SG–71/FCC until the ME–6/U reads .775 volt. Then set the TS–402/U for 8-db loss. Connect test-signal setup to terminals A and M of supply test-cable assembly. Operate SELECTOR switch to AMP 1 IN 1 KC position. Meter (M1) should read 0 ±1 db.	Meter does not read 0 ±1 db.	Defect between terminal A of connector P1 and tube V1 through AMP 1 IN 1 KC contacts of SELECTOR switch. R8 control not properly adjusted.	Check wiring from terminal A of P1 through AMP 1 IN 1 KC contacts of SELECTOR switch. Check through filter FL2 to terminal 6 of tube V1. Adjust R8 in accordance with instructions in paragraph 143. If unable to adjust, check filter FL2 (par. 120) and resistors R7 and R8.
20. Disconnect test signal clip from terminal A and connect it to terminal C of supply test-cable assembly. Operate SELECTOR switch to AMP 1 OUT 1 KC position. Meter (M1) should read 0 ±1 db.	Meter does not read 0 ±1 db.	Defect between terminal C of P1 and terminal 6 of V1, through AMP 1 OUT 1 KC contacts of SELECTOR switch.	Check wiring from terminal E of P1 through SELECTOR switch and 1 KC SENS switch, to terminal 6 of tube V1.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
21. Disconnect test-signal clip from terminal C and connect it to terminal R of supply test-cable assembly. Operate SELECTOR switch toAMP 2 IN 1 KC position. Meter (M1) should read 0 ± 1db.	Meter does not read 0 ±1 db.	Defect between terminal R of P1 and terminal 6 of tube V1, through AMP 2 IN 1 KC contacts of SELECTOR switch.	Check wiring from terminal R of P1 through SELECTOR switch and 1 KC SENS switch, to terminal 6 of tube V1.
22. Disconnect test-signal clip from terminal R and connect it to terminal E of supply test-cable assembly. Operate SELECTOR switch to AMP 2 OUT 1 KC position. Meter (M1) should read 0 ±1 db.	Meter does not read 0 ±1 db.	Defect between terminal E of P1 and tube V1 through AMP 2 OUT 1 KC position of SELECTOR switch.	Check wiring from terminal E of connector P1 through SELECTOR switch S1 and 1 KC SENS switch S2 to terminal 6 of tube V1.
23. Connect ME–6/U across terminals 1 and 2 of filter FL2 (terminal 2 is ground). Operate 1 KC SENS switch to LOW position. The ME–6/U should read between .027 and .035 volt. Remove the test-signal setup and the ME–6/U connections from the TS/712 test set when this test is completed.	The ME–6/U reads outside limits of .027 and .035 volt.	Defect in 1 KC SENS switch S2. Resistor R5 or R6 defective.	Check wiring through 1 KC SENS switch S2 in LOW position. Check resistors R5 and R6.
24. Operate OW GAIN switch to HIGH position. Operate ORDER WIRE switch to RING position. Connect Telephone EE–8–( ) to binding posts L1 and L2. Connect the ME–6/U to terminals L and M of supply test-cable assembly. Operate handcrank of the EE–8–( ) at normal speed. The ME–6/U should read between .17 and .775 volt ac.	The ME–6/U reading is outside limits of .17 and .775 volt ac.	Defect in 1,600-cycle oscillator circuit.	Use signal substitution tests (par. 134) to localize faulty part.
25. Disconnect the ME–6/U and connect Frequency Meter FR–67/U across terminals L and M of supply test-cable assembly. Operate handcrank of the EE–8–( ) at normal speed. The FR–67/U should indicate 1,600 ±10 cps. Disconnect the EE–8–( ) and the FR–67/U when this test is completed.	FR–67/U indicates that frequency is outside limits of 1,600 ±10 cps.	1,600-cycle oscillator out of alinement.	Adjust frequency of oscillator in accordance with alinement procedures (par. 144). If unable to adjust properly, check T2, C11, C12, C13, C14, and C15.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
26. Set up order-wire test signal (fig. 27 and par. 116*c*). Connect 600-ohm resistor between L and M and another 600-ohm resistor between N and M of supply test-cable assembly. Set the ME–6/U to the .1-volt scale. Connect the ME–6/U across terminals L and M of supply test-cable assembly (terminal M is ground). Operate ORDER WIRE switch to TALK position. Operate OW GAIN switch to LOW position. The ME–6/U should read 13.5±1.5 db.	The ME–6/U reads outside limits of 13.5±1.5 db.	Defect between connector P1 and binding posts L1 and L2.	Check wiring from terminal L of connector P1, through OW GAIN switch, transformer T3, and ORDER WIRE switch S5, to binding posts L1 and L2. Check resistors R33, R34, R35 and capacitor C3.
27. Set the ME–6/U to 1-volt range. Operate OW GAIN switch to MED position. The ME–6/U should read 1.7±1.5 db.	The ME–6/U reads outside limits of 1.7±1.5 db.	Defect between terminal L of P1 and T3 through OW GAIN switch in MED position.	Check wiring from terminal L of P1 through MED position contacts of OW GAIN switch S6 to T3. Check resistors R36 and R37.
28. Operate OW GAIN switch to HIGH position. The ME–6/U should read 7.5 ±1.5 db.	The ME–6/U reads outside limits of 7.5 ±1.5 db.	Defect between terminal L of P1 and T3 through OW GAIN switch in HIGH position.	Check wiring from terminal L of P1, through OW GAIN switch HIGH position contacts, to T3 Check R38.
29. Disconnect the ME–6/U from terminals L and M and connect the ME–6/U to terminals N and M of supply test-cable assembly. The ME–6/U should read 2.1 ±1.5 db.	The ME–6/U reads outside limits of 2.1 ±1.5 db.	Defect between terminal N of P1 and T3, through HIGH contacts of OW GAIN switch.	Check wiring from terminal N of P1, through HIGH contacts of OW GAIN switch S6, to T3. Check R39, R44, and C4.
30. Operate OW GAIN switch to MED position. Set the ME–6/U to .1-volt range. The ME–6/U should read 10.2 ±1.5 db.	ME–6/U reads outside limits of 10.2 ±1.5 db.	Defect between terminal N of P1 and T3, through MED position of OW GAIN switch.	Check wiring from terminal N of P1 to T3, through MED contacts of OW GAIN switch. Check R42, R43, and R45.
31. Operate OW GAIN switch to LOW position. The ME–6/U should read 1.5 ±1.5 db. When this test is completed, disconnect test-signal set-up, the ME–6/U, and all resistors from supply test-cable assembly.	ME–6/U reads outside limits of 1.5 ±1.5 db.	Defect between terminal N of P1 and T3, through LOW position of OW GAIN switch.	Check wiring from terminal N of connector P1, through OW GAIN switch S6 in LOW position, to T3. Check R40, R41, and R46.

117. Troubleshooting Chart—Continued

Test	Symptom	Probable trouble	Correction
32. With the TS–352/U, measure resistance from terminal D of supply test-cable assembly to terminals listed below. Set SELECTOR switch to corresponding positions. Each TS–352/U reading should be more than 1 megohm.	Resistance at any position is less than 1 megohm.	Defective blocking capacitors as listed below.	Check corresponding capacitors listed below.
Terminal *Selector switch position*			
C AMP 1 OUT 1 KC		C5	C5.
A AMP 1 IN 1 KC		C1	C1.
E AMP 2 OUT 1 KC		C6	C6.
R AMP 2 IN 1 KC		C2	C2.
M Any position		C8	C8.
33. With the TS–352/U, measure resistance from terminal M of supply test-cable assembly to terminals L and N. (Switches may be in any position.) Each TS–352/U reading should be more than 1 megohm.	Resistance is less than 1 megohm on either or both terminals L and N.	Defective blocking capacitor C3 or C4.	Check capacitors C3 and C4.
34. Test artificial cable Z1 as outlined in paragraph 155.	Artificial cable Z1 fails to meet requirements of paragraph 155.	Defect in artificial cable Z1.	Use signal substitution (par. 135) to find faulty part.

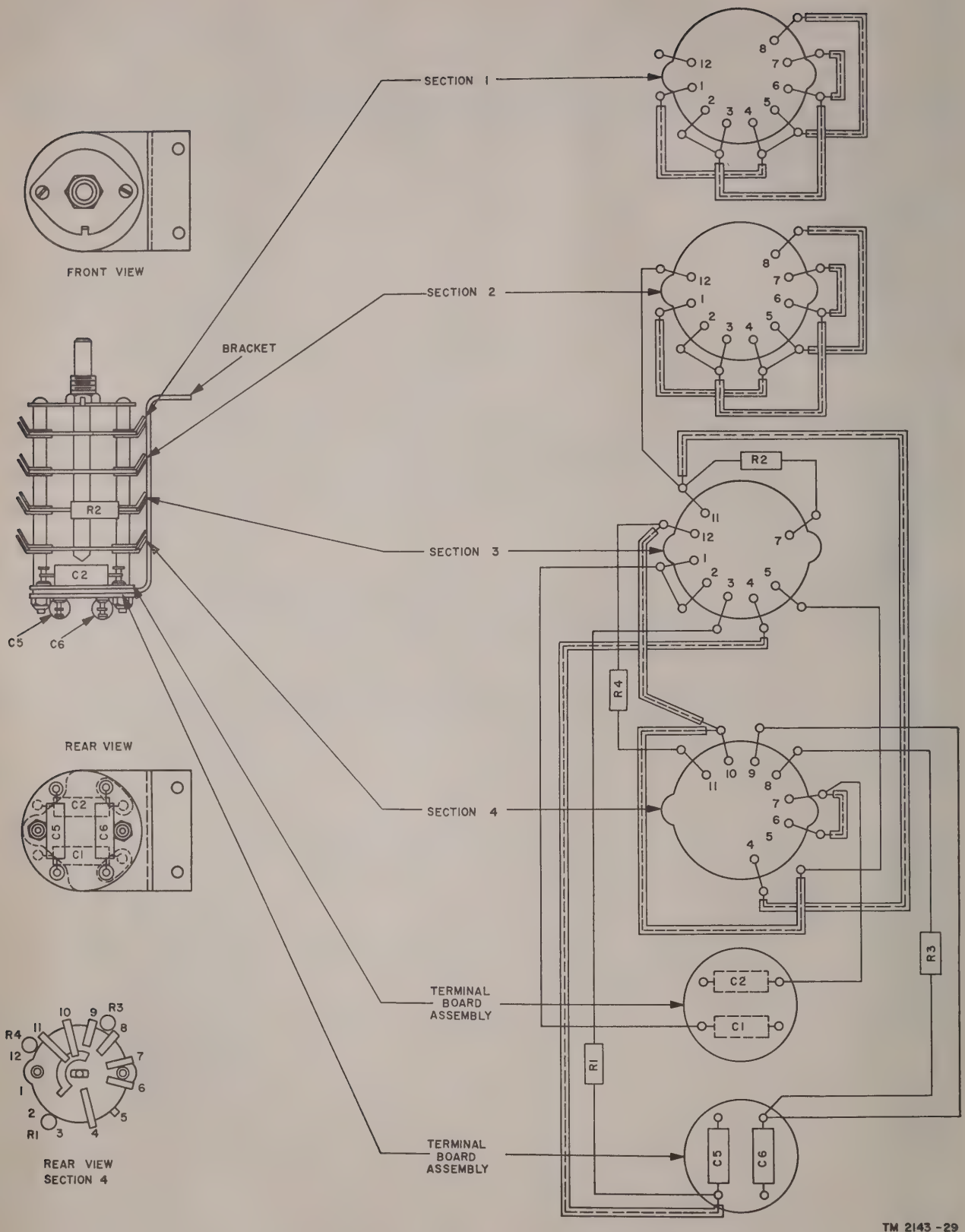


Figure 28. Telephone Test Set TS-712/TCC-11, SELECTOR switch S1, wiring diagram.

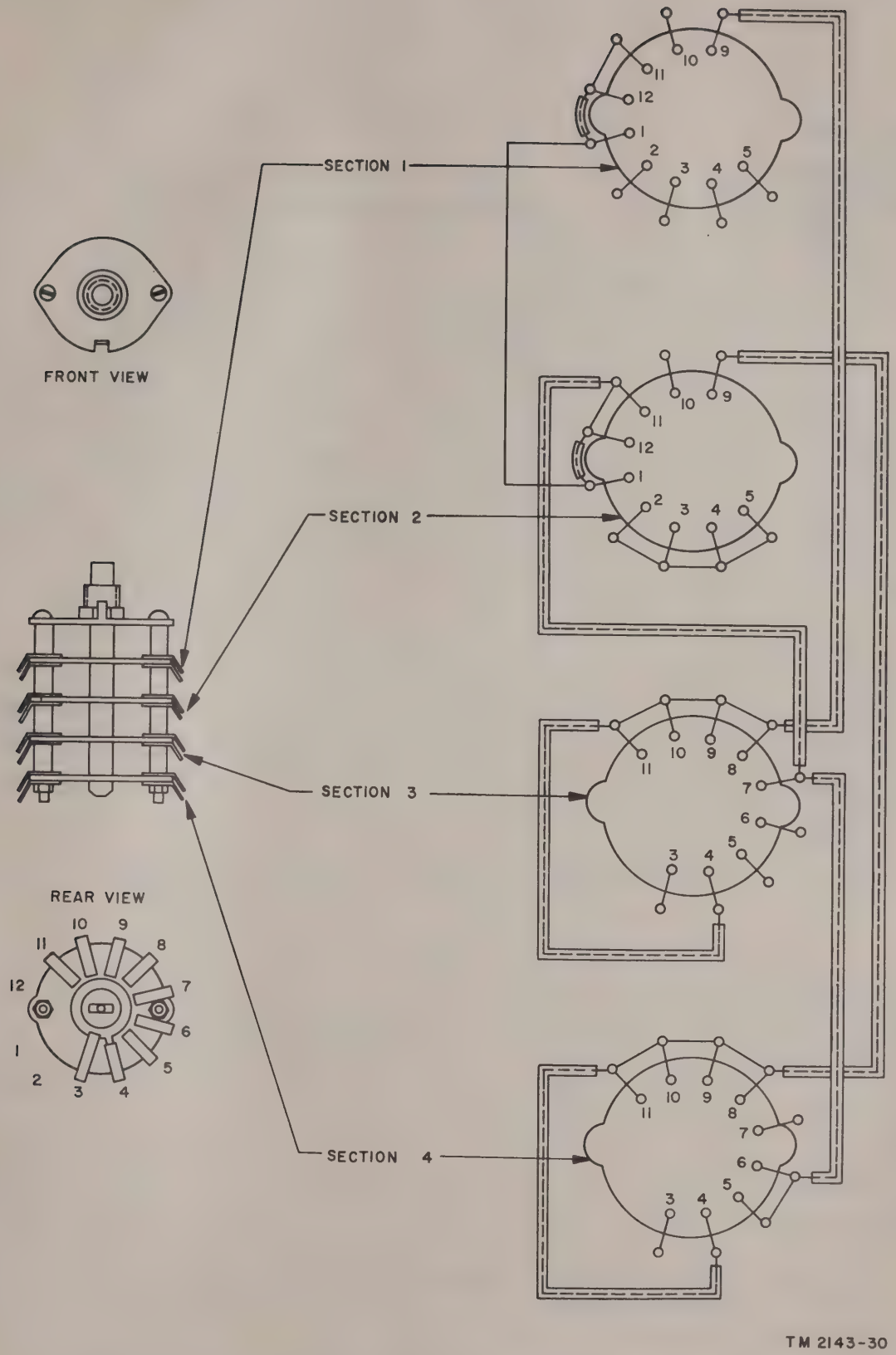


Figure 29. Telephone Test Set TS–712/TCC–11, MEASURE switch S3, wiring diagram.

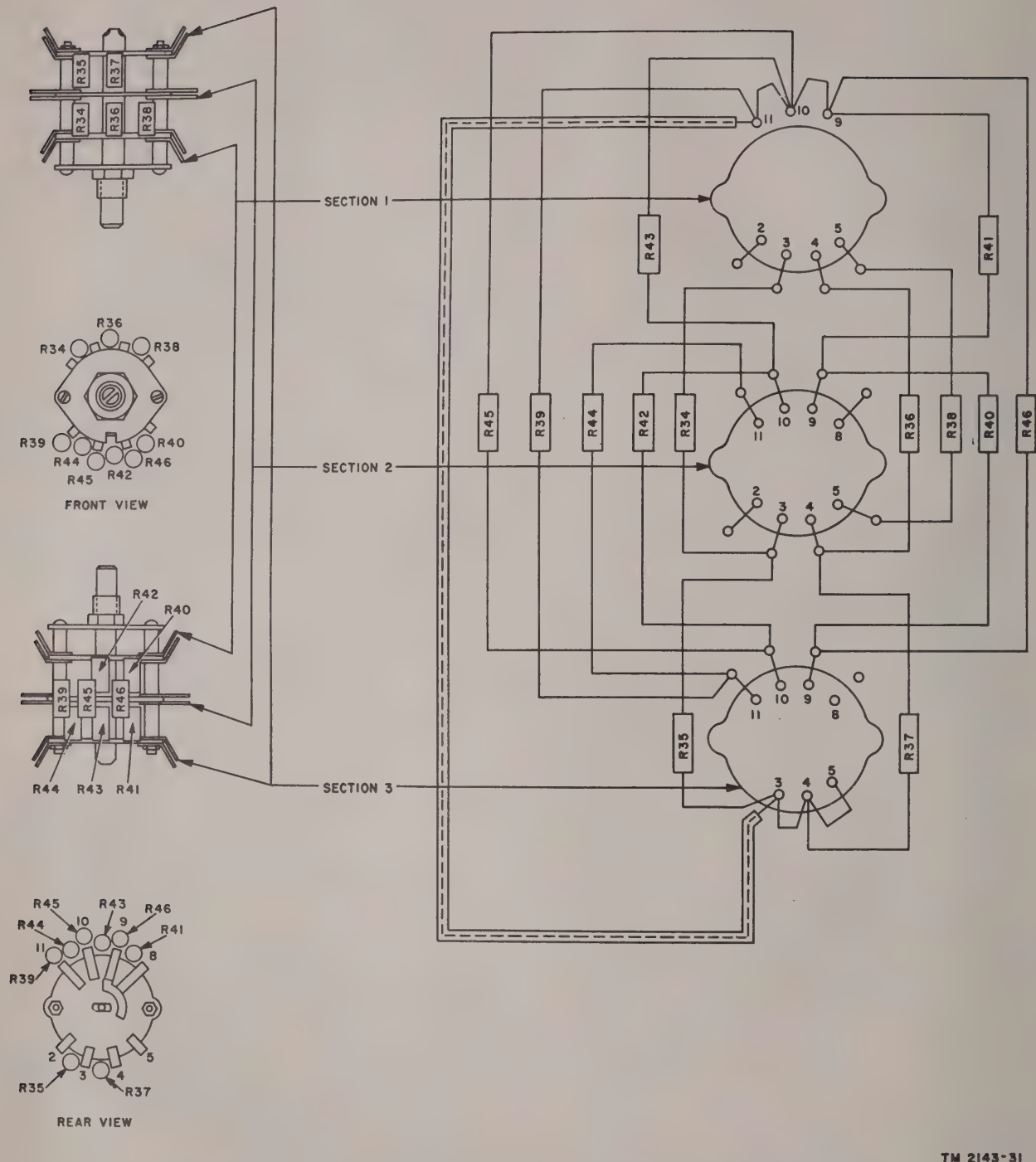
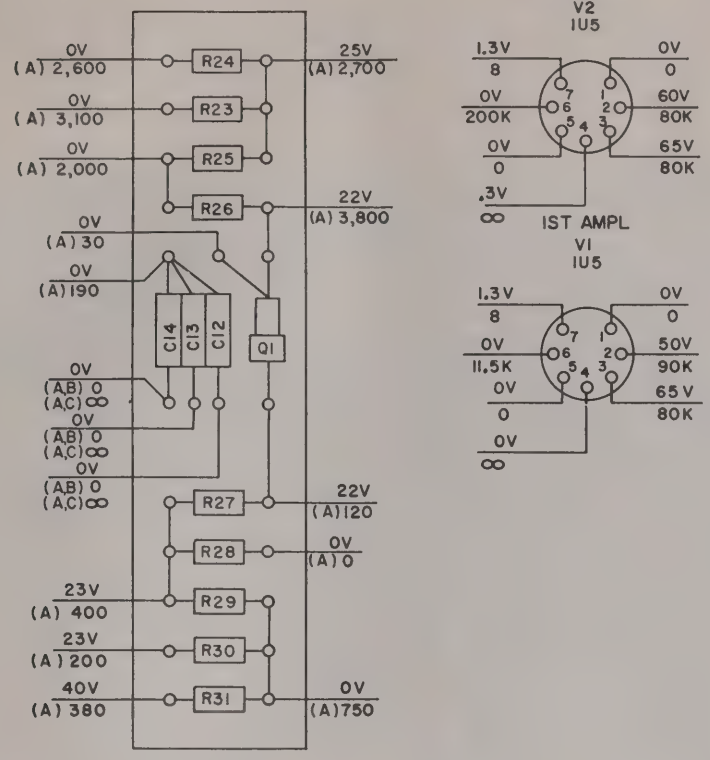


Figure 30. Telephone Test Set TS-712/TCC-11, OW GAIN switch S6, wiring diagram.



NOTES:

1. ALL MEASUREMENTS ARE MADE WITH TS-712 TEST SET NOT CONNECTED TO TELEPHONE REPEATER AN/TCC-11.
2. DO NOT ATTEMPT TO TAKE RESISTANCE MEASUREMENTS WITH POWER ON. RESISTANCE MEASUREMENTS ARE MADE WITH THE [POWER] SWITCH IN THE [OFF] POSITION, AND THE [ORDER WIRE] SWITCH IN THE [TALK] POSITION.
3. VOLTAGE MEASUREMENTS ARE SHOWN ABOVE LINE, RESISTANCE MEASUREMENTS BELOW.
4. D-C VOLTAGE MEASUREMENTS ARE TAKEN WITH A 20,000-OHMS-PER-VOLT METER. USE HIGH METER RANGES TO PREVENT CIRCUIT LOADING.
5. UNLESS OTHERWISE INDICATED, ALL TUBE SOCKET VOLTAGE MEASUREMENTS ARE TAKEN FROM TEST POINT TO GROUND (CHASSIS) WITH THE [POWER] SWITCH IN THE [ON] POSITION AND WITH BATTERY VOLTAGES PROPERLY ADJUSTED.
6. RESISTOR-CAPACITOR BOARD VOLTAGE MEASUREMENTS ARE MADE WITH THE [ORDER WIRE] SWITCH IN THE [RING] POSITION AND A TELEPHONE EE-8-( ) CONNECTED TO [TEL] BINDING POSTS. THE GENERATOR OF TELEPHONE EE-8-( ) IS OPERATED AT NORMAL SPEED (200 RPM) FOR THESE MEASUREMENTS.
7. A INDICATES MEASUREMENT FROM TEST POINT TO TERMINAL 3 OF TRANSFORMER T2.
8. B INDICATES MEASUREMENT OBTAINED WHEN THE CAPACITOR IS CONNECTED TO RESISTOR R28.
9. C INDICATES MEASUREMENT OBTAINED WHEN THE CAPACITOR IS CONNECTED TO RESISTOR R28.
10. ALL VOLTAGES ARE DC.

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Figure 31. Telephone Test Set TS-712/TCC-11, tube-socket and resistor-board voltage and resistance diagram.

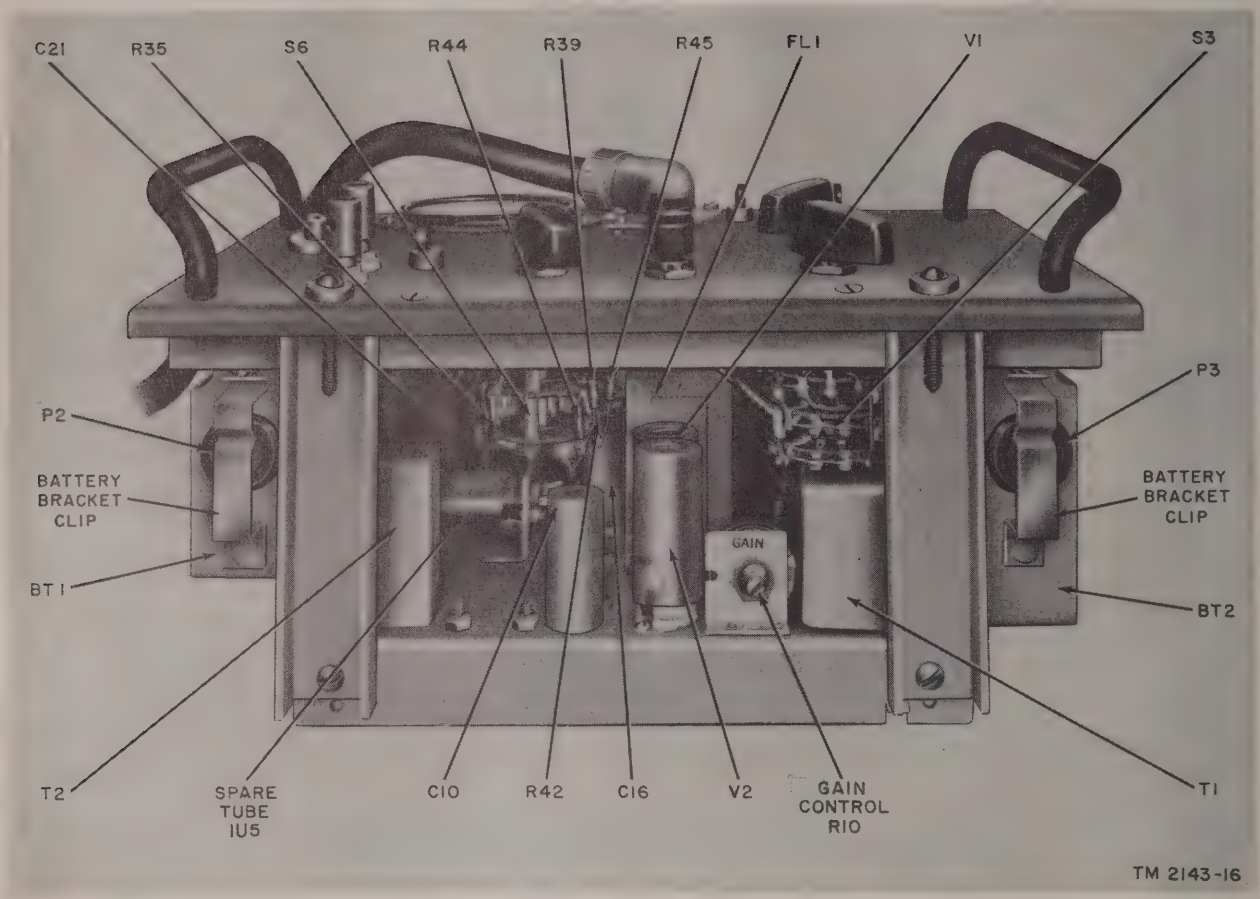


Figure 32. Telephone Test Set TS-712/TCC-11, side view of chassis showing GAIN control.

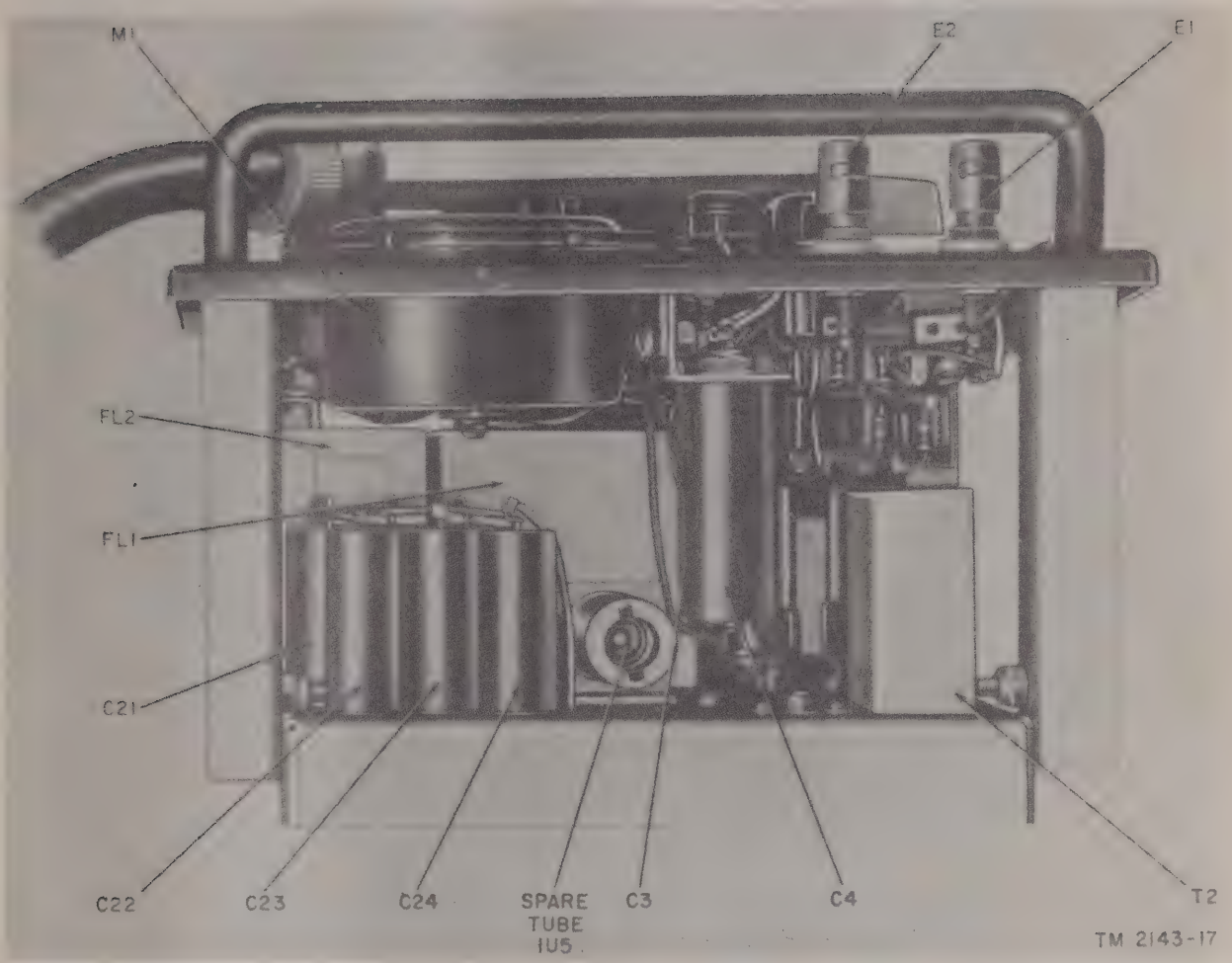


Figure 33. Telephone Test Set TS–712/TCC–11, left end view of chassis with battery bracket and battery removed.

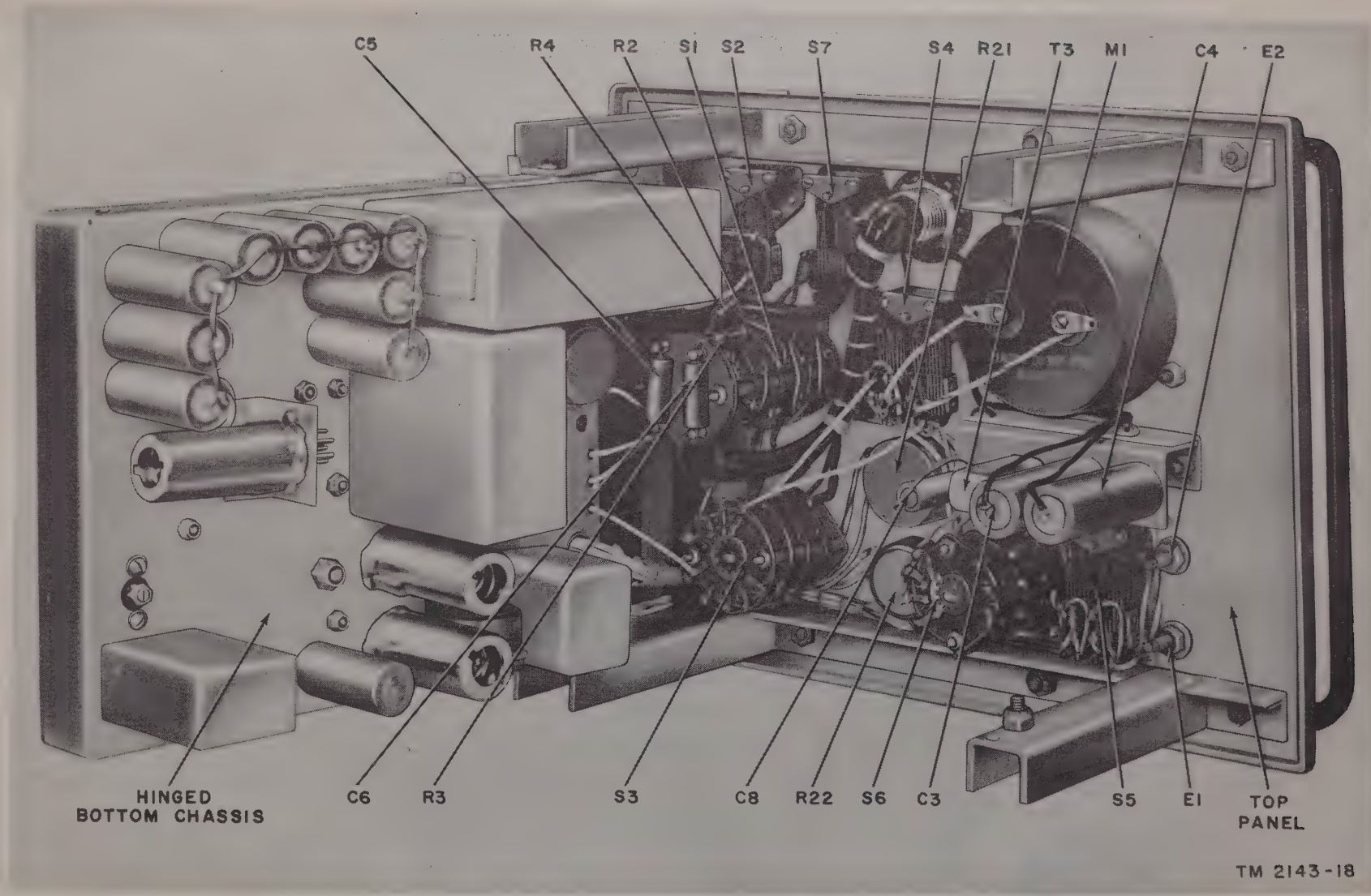


Figure 34. Telephone Test Set TS–712/TCC–11, bottom chassis swung out, showing rear of top panel, battery bracket and battery removed.

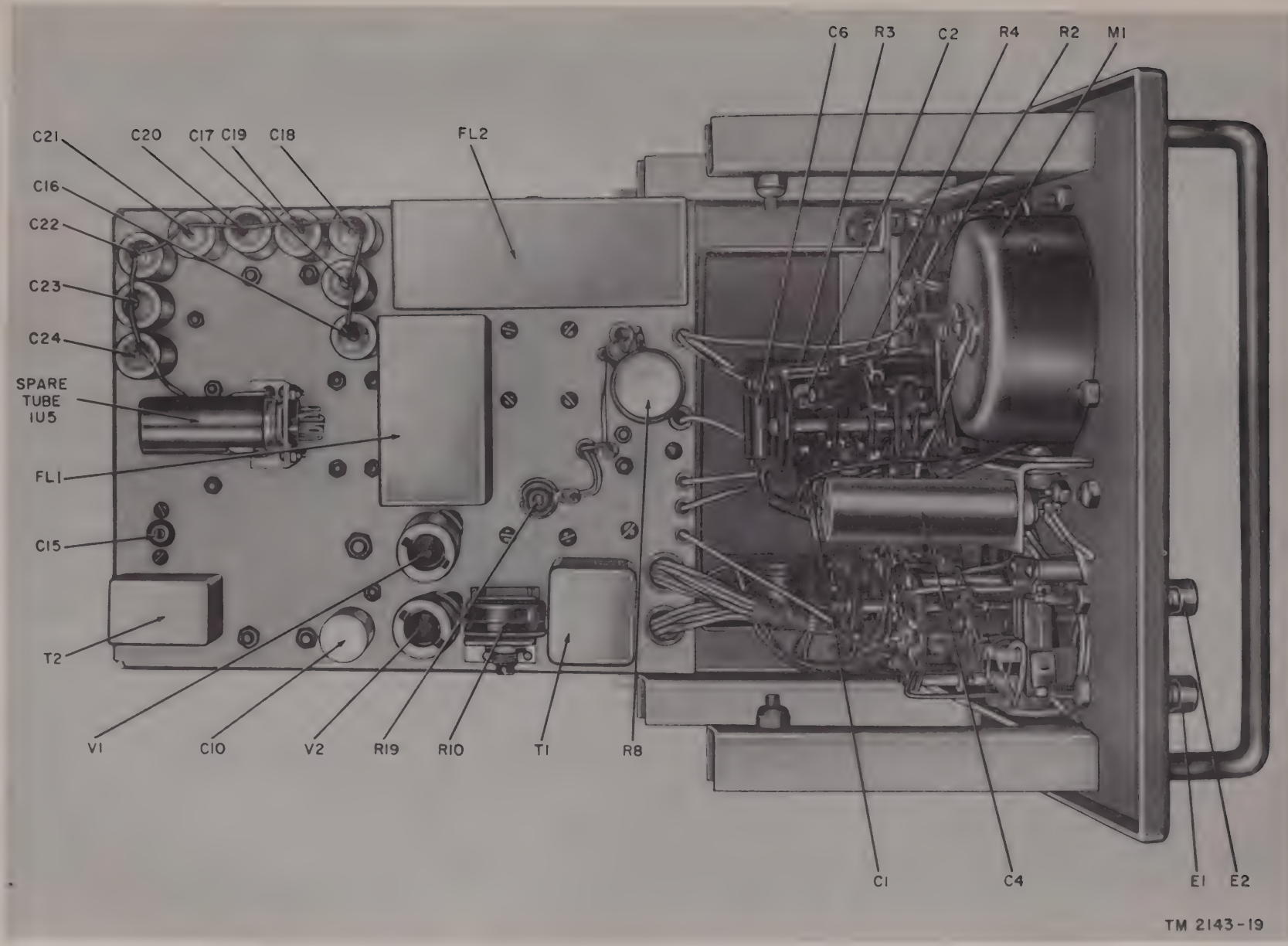


Figure 35. Telephone Test Set TS-712/TCC-11, bottom chassis swung out, showing top of bottom chassis.

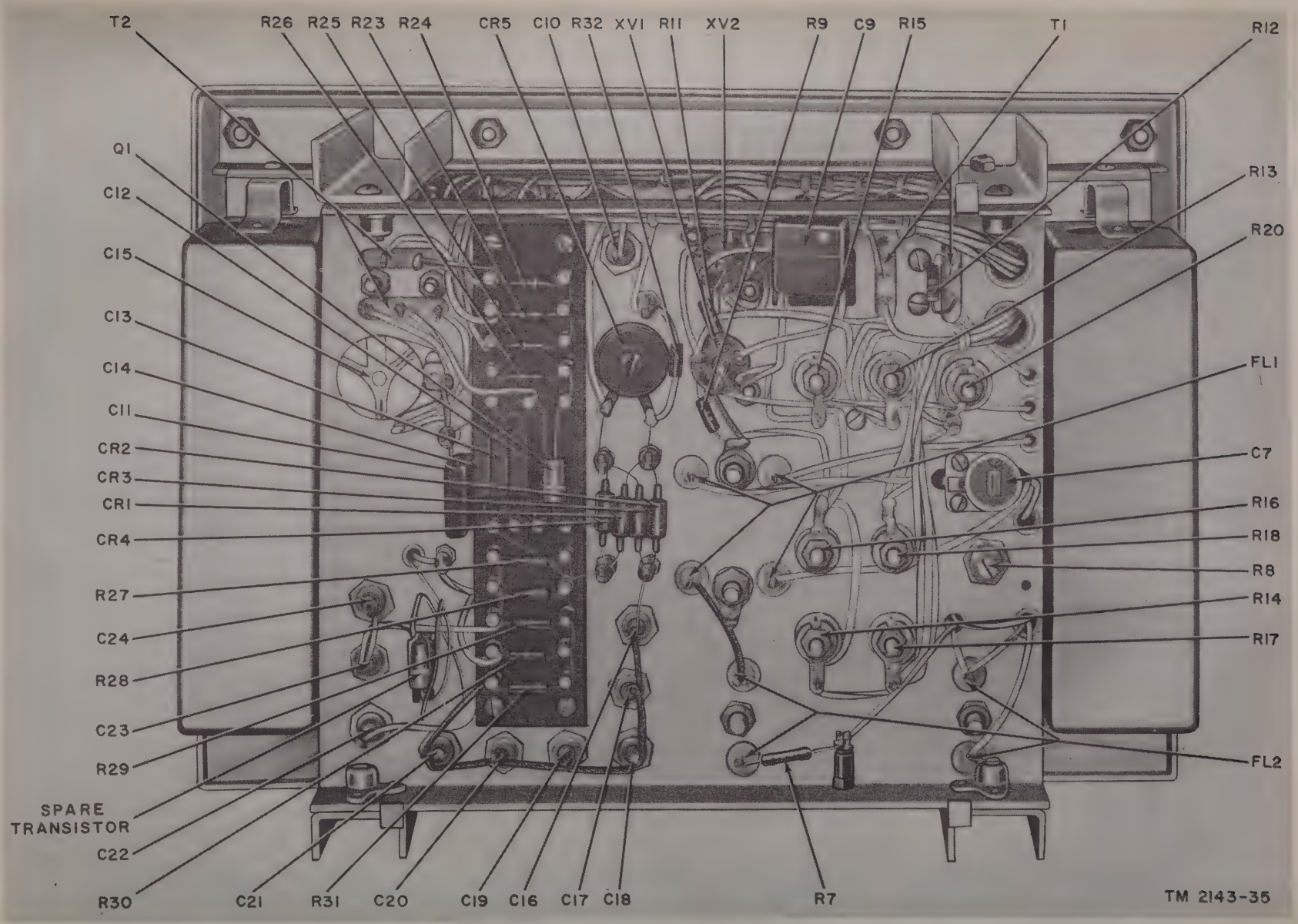


Figure 36. Telephone Test Set TS–712/TCC–11, bottom view of bottom chassis.

118. Additional Troubleshooting Information

Paragraphs 120 through 130 contain information to be used in testing the parts of the TS–712 test set. Test equipment required for these tests is listed in paragraph 119.

119. Tools and Test Equipment Required for Additional Troubleshooting

The following table lists the test equipment required for the additional troubleshooting tests.

Test equipment	Technical manual	No. reqd.
Analyzer ZM–3/U or equal	TM 11–5043	1
Electronic Multimeter ME–6A/U or equal.	TM 11–5549	1
Multimeter TS–352/U or equal.	TM 11–5527	1
Resistor, 365.9 ohms ± 1%, ½ w, consists of resistor, 301 ohms ± 1%, ½ w, Sig C stock No. 3Z6030A1–6 and resistor 64.9 ohms ± 1%, ½ w, Sig C stock No. 3Z6006D4–1.		2
Resistor, 470 ohms ± 1%, ½ w, Sig C stock No. 3Z6047–37.		2
Resistor, 600 ohms ± 1%, ½ w, Sig C stock No. 3Z6060–119.		2
Resistor, 1,800 ohms ± 5%, ½ w, Sig C stock No. 3RC20BF182J.		2
Resistor, 2,200 ohms ± 5%, ½ w, Sig C stock No. 3RC20BF222J.		2
Resistor, 20K ± 1%, ½ w, Sig C stock No. 3Z6620–228.		1
Resistor, 27K ± 5%, ½ w, Sig C stock No. 3RC20BF273J.		1
Resistor, 33K ± 5%, ½ w, Sig C stock No. 3RC20BF333J.		1
Resistor, 100K ± 5%, ½ w, Sig C stock No. 3RC20BF104J.		3
Signal Generator SG–71/FCC or equal.		1
Meter Test Equipment AN/GSM–1.	TM 11–2535	1

120. Testing of Filters FL1 and FL2 and Artificial Cable Z1, General

A filter or the artificial cable Z1 is checked by removing it from the TS–712 test set and measuring the loss of the filter or artificial cable Z1 at specific frequencies. They are complete subassemblies. Defective subassemblies must be replaced; they cannot be repaired. The procedure for testing the filters and artificial cable Z1 of the TS–712 test set is outlined in paragraph 121.

121. Tests for Filters FL1 and FL2 and Artificial Cable Z1

Follow the procedure oulined in *a* and *b* below to check filters FL1 and FL2 and artificial cable Z1. Test equipment required for these tests is listed in paragraph 119.

a. Set up the test equipment as shown in A, figure 37. This pretest setup is used to obtain the proper frequency and output level before the filter or artificial cable is tested. Follow the procedure outlined in (1) through (4) below to make the pretest setup.

(1) Insert the proper value resistors for A and B into the pretest setup, as outlined in the test table of *b*(4) below.

(2) Adjust Signal Generator SG–71/FCC to the first frequency outlined in the test table for the subassembly under test.

(3) Set Electronic Multimeter ME–6/U on the 1-volt range and connect it across resistor B.

(4) Adjust the SG–71/FCC output control for a reading on the ME–6/U as outlined in the test table.

b. Follow the procedure outlined in (1) through (4) below to test the filter or artificial cable.

(1) Insert the filter or artificial cable into the circuit as shown in B, figure 37.

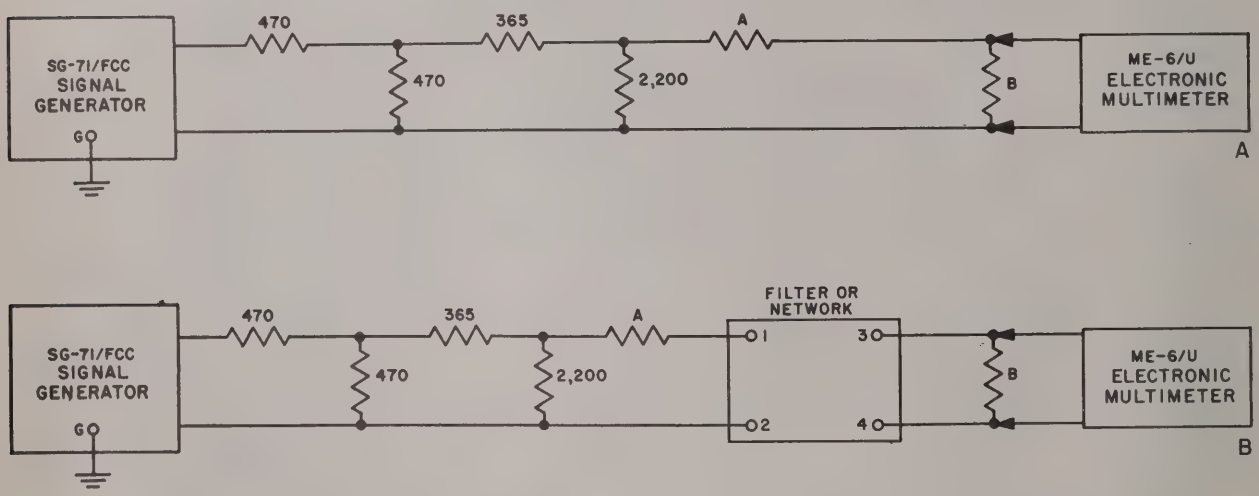
(2) Set Electronic Multimeter ME–6/U to the range indicated in the ME–6/U range column in the test table of (4) below.

(3) The ME–6/U output reading should be the same as the reading given in the last column in the test table.

(4) Repeat the test procedures listed in *a* above and in (1) through (3) above for each frequency listed in the table below for the filter or artificial cable Z1 under test. The test table follows.

Filter or artificial cable Z1	Resistors		Signal Generator SG–71/FCC test frequency	Signal Generator SG–71/FCC test level as read on Electronic Multimeter ME–6/U on 1-volt range (a-c volts)	Electronic Multimeter ME–6/U range for output reading	Electronic Multimeter ME–6/U output reading (a-c volts)
	A	B				
FL1	0	227K*	55 kc	10	0. 01	20 max.
			68 kc	10	1. 0	8 min.
			75 kc	10	. 1	20 max.
FL2	0	153K*	10 cps	10	. 01	15 max.
			500 cps	10	. 1	10 max.
			1,500 cps	10	1. 0	8 min.
Artificial cable Z1	*1, 200	1,800	5 kc	20	. 01	5 max.
			20 kc	10	. 1	152.5 max.
			60 kc	10	. 1	103 max.

*These resistors are not available, but equivalent resistances can be obtained as follows:
(1) 227K=100K+100K+27K (in series).
(2) 153K=100K+20K+33K (in series).
(3) 1,200 ohms=600 ohms+600 ohms (in series).



NOTES:

1. RESISTORS ARE IN OHMS.
2. VALUES FOR RESISTORS A AND B USED IN TEST SETUPS ARE GIVEN IN TEXT ASSOCIATED WITH TEST.

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Figure 37. Telephone Test Set TS–712/TCC–11, filters FL1, FL2, and artificial cable Z1, test setups.

122. Test of Resistors, Fixed and Variable

a. Fixed Resistors. If it is suspected that a resistor is faulty, check the resistor with an ohmmeter. To be certain that only the resistor is being checked, disconnect at least one end of the resistor from the circuit. The resistance value of each resistor in the TS–712 test set appears in the identification table of parts (app. II).

b. Variable Resistors. Variable resistors can be defective in one of several ways. They can open, change value, or become noisy.

(1) To check a variable resistor, tag and unsolder all connections to it.

(2) Use an ohmmeter to measure the resistance between the outside terminals of the variable resistor.

(3) Connect the ohmmeter to one of the outside terminals and the center terminal. Rotate the front panel control knob with a slow and even motion from the extreme counterclockwise position to the extreme clockwise position. The indication on the ohmmeter should change steadily either from 0 ohms to its specified value or from its specified value to 0 ohms, depending on which of the outside terminals is connected to the ohmmeter. Any sudden jump or dip of the ohmmeter needle indicates that the control is noisy and should be replaced.

(4) There should be an open circuit between any terminal on the variable resistor and the outside shell when checked with an ohmmeter.

123. Test of Capacitors

To check a capacitor, discharge it and remove at least one of its leads from the circuit. Check the capacitor with a capacity analyzer or by replacing the capacitor with one that is known to be good.

124. Test of Transformers

Transformers may become defective in several ways. A winding can open, several turns of the winding can become shorted, one winding can become connected internally to another winding, or a winding can become shorted to the core of the transformer. Use an ohmmeter to check the insulation between the windings and the core. Also check the resistance between separate windings. Check the schematics to determine whether any external connections are made between windings or between the winding and the core of the transformer. Use an ohmmeter to check the resistances of the transformers. The resistance of windings of transformers are listed in paragraph 125.

125. D-C Resistance of Transformers

The table below lists the d-c resistance of the transformers in Telephone Test Set TS–712/TCC–11.

Note. Measure the resistance of transformers with all connections and straps removed from the terminals.

Telephone Test Set TS–712/TCC–11

Transformer	Terminals	Resistance (ohms)
(Z1) T1, (Z1) T2	1—2	4. 89
	3—4	4. 88
	5—6	90. 1
T1	1—2	1, 100
	3—4	1, 350
T2	1—2	2. 6
	3—4	24
	3—5	185
T3	1—3	75
	4—6	240

126. Test of Varistors

If a varistor is suspected of being faulty, disconnect it from the circuit. Note the polarity markings of the varistor being removed. Connect a new varistor into the circuit in such a manner that its polarity coincides with the polarity of the varistor that was removed. If the circuit operates normally with the new varistor, the replaced one was faulty.

127. Test of Switches

Check the switches by checking continuity between contacts with an ohmmeter. Use the information in the diagrams (fig. 43) to determine between which points continuity should exist in each switch position.

128. Test of Meter M1

The accuracy of the TS–712 test set meter M1 is checked with Test Equipment Meter AN/GSM–1. Instructions for the use of the AN/GSM–1 are in TM 11–2535. To test meter M1 proceed as follows:

a. Disconnect meter M1 from the TS–712 test set. Adjust the zero-set screwdriver adjustment on meter M1 until the pointer rests at the mark at the left end of the scale.

b. Connect meter M1 to Test Equipment Meter AN/GSM–1.

c. Adjust Test Equipment Meter AN/GSM–1 until TS–712 test set meter M1 reads 0 db. The AN/GSM–1 meter should read 31 ±5 microamperes.

d. Adjust Test Equipment Meter AN/GSM–1 until TS–712 test set meter M1 pointer deflects to the BAT mark. The AN/GSM–1 meter should read 66 ±5 microamperes.

e. Adjust Test Equipment Meter AN/GSM–1 until TS–712 test set meter M1 reads +8 db. The AN/GSM–1 meter should read 100 ±5 microamperes.

f. If meter M1 does not meet the requirements of the procedure outlined in *a* through *e* above, replace meter M1.

129. Check of Transitor Q1

When trouble in the TS–712 test set indicates that transitor Q1 is defective, check the transitor by replacing it with a transitor known to be good. If the new transitor restores normal operation, the replaced transitor was defective. Observe transitor markings when replacing them.

130. Rectifier Test

The elements that are marked CR1, CR2, CR3, CR4, or CR5 on schematic diagrams are varistors whose function it is to provide rectification. Follow the procedure in paragraph 126 for testing varistors.

131. Signal Substitution Tests, Telephone Test Set TS–712/TCC–11

The purpose of the signal substitution tests is to supplement the procedures outlined in the troubleshooting chart (par. 117) for localizing trouble to a defective part. Test equipments required for these tests are listed in paragraph 113. The signal substitution tests consist of the following:

a. Signal substitution test setup (par. 132).
b. Transmission test circuit test (par. 133).
c. 1,600-cycle oscillator test (par. 134).
d. Artificial cable Z1 test (par. 135).

132. Signal Substitution Test Setup, TS–712 Test Set

The purpose of the signal substitution test setup is to prepare the TS–712 test set for the signal substitution tests. Refer to the applicable figures for the location of parts discussed in the tests. Troubleshooting data is listed in paragraph 112.

a. Arrange the equipment as shown in B, figure 26 to supply terminating resistors to the TS–712 test set. This also makes the terminals of connector P1 available as connection points on the supply test-cable assembly. The 1.5-volt battery, 15K resistor, 15K variable resistor, adjustable power supply, and the 12K resistor are not required for these tests.

b. Arrange the equipment as shown in figure 26 for test signals to be used in the transmission test circuit test (par. 133).

c. Arrange the equipment as shown in figure 38 for testing artificial cable Z1 (par. 135).

d. Power is supplied to the transmission circuit of the TS–712 test set by plug-in batteries BT1 and BT2. Connect these batteries before proceeding with the signal substitution tests (par. 133).

e. Check and repair, if necessary, the wiring and soldering in each part of the circuit during the procedures.

f. Make all tests with the TS–712 test set removed from its carrying case.

g. Perform the tests in the sequence given. Isolate and clear any trouble located before proceeding with any succeeding steps.

h. Except where definite limits are given, the test values given in the procedures are typical and may vary in different TS–712 test sets. Sound judgment should be used in deciding when a trouble is indicated.

i. After troubles have been cleared in a TS–712 test set, aline the TS–712 test set as outlined in the alinement procedures (par. 139).

133. Transmission Test Circuit Signal Substitution Test

The following procedure outlines tests for transmission test circuits of the TS–712 test set for the AMP 1 IN 68 KC position of the SELECTOR switch. When all troubles in this position of the switch have been cleared, use the troubleshooting chart (par. 117, tests 16 through 23) if trouble exists on other positions of the switch. To make the following test, set up the equipment in accordance with instructions in paragraph 132 *a*, *b*, and *d* and proceed as follows:

a. Adjust the batteries as follows:
(1) Operate the POWER switch to the ON position and the MEASURE switch to the A BAT position. Adjust the A BAT control until meter M1 reads at the BAT mark.

(2) Operate the MEASURE switch to the B BAT position and adjust the B BAT control until meter M1 reads at the BAT mark.

(3) Check these adjustments from time to time during the tests. Allow a warmup period of at least 10 minutes before making the tests. If any troubles are encountered in making the above adjustments, use the troubleshooting chart (par. 117, tests 1 through 4) for locating the trouble.

b. Set the frequency of Signal Generator SG–71/FCC to 68 kc ±100 cycles with Frequency Meter FR–67/U. With no connection to the test jack and with Attenuator TS–402/U set at 0 db, adjust Signal Generator SG–71/FCC output control for a reading of .775 volt on Electronic Multimeter ME–6/U (connected across the 135-ohm resistor). Remove the Electronic Multimeter ME–6/U connections.

c. Operate the MEASURE switch to the TRANS position and the SELECTOR switch to the AMP 1 IN 68 KC position. Set Attenuator TS–402/U to 8 db. Connect the test clip of the test cord to terminal 6 of tube V2, and the ground clip to chassis ground. Insert the plug of the test cord in the test jack (fig. 26). Adjust the GAIN control to its maximum clockwise position. The TS–712 test set meter reading should be 0 db or more. If it is, proceed with *d* below. If it is not, measure the voltage from terminal 2 of tube V2 to chassis ground with Electronic Multimeter ME–6/U. The meter reading should be 1.2 volts. If trouble is indicated, check tube V2 and make tube socket voltage and resistance measurement (fig. 31). Check transformer T1 (par. 125) and resistor R11. Check resistor R12. Check the wiring from terminal 1 of transformer T1 through the MEASURE switch and the POWER switch to the negative side of meter M1. Also check the wiring from the positive side of meter M1 through the POWER and MEASURE switches to chassis ground.

Caution: When checking this wiring with Multimeter TS–352/U (set on ohms), remove the connections from meter M1. Otherwise the meter may be damaged.

d. Set Attenuator TS–402/U for an 18-db loss and connect the test clip to terminal 6 of tube VI. Meter M1 should read ±2 db or more. If it does not, check tube V1, resistor R11, and capacitor C9. If trouble is still indicated, make the tube-socket voltage and resistance measurements. When all troubles are cleared, adjust the GAIN control until meter M1 reads 0 db.

e. Connect the test clip to terminal 3 of filter FL1. Meter M1 should read 0 db. If it does not, check the wiring from terminal 3 of filter FL1 to terminal 6 of tube V1. Check resistor R9.

f. Connect the test clip to terminal A of the supply test cable assembly (fig. 26) and the ground clip to terminal M. Arrange Attenuator TS–402/U for a 23-db loss. Meter M1 should read 0 ±2 db. If it is within these limits, adjust the GAIN control until meter M1 reads 0 db. If it is out of these limits, check the wiring from terminal A of connector P1 through SELECTOR switch S1, to filter FL1. Check capacitors C7 and C8. Realine the transmission test circuit in accordance with paragraph 143. If unable to adjust properly by realinement, check filter FL1 (par. 120). When all troubles are cleared, adjust the GAIN control until meter M1 reads 0 db.

134. Signal Substitution Test, 1,600-Cycle Oscillator Circuit

(fig. 26)

The following procedure is used to check the power output of the 1,600-cycle oscillator circuit in the TS–712 test set for the HIGH position of the OW GAIN switch. For troubles on other positions of the OW GAIN switch, use the troubleshooting chart (par. 117, tests 26 through 31). To make this test, connect the equipment as indicated in paragraph 132*a* and *b* and proceed as follows:

a. Connect Telephone EE–8–( ) to binding posts L1 and L2 of the TS–712 test set. Operate the OW GAIN switch to the HIGH position and the ORDER WIRE switch to the RING position. Check to see that the 600-ohm terminations are connected across terminals L and M and terminals N and M of the supply test-cable assembly (fig. 26). All voltage readings in these tests are made while the handcrank of Telephone EE–8–( ) is being turned at normal speed.

b. Measure the voltage across binding posts L1 and L2 with Electronic Multimeter ME–6/U. It should be approximately 65 volts. If it is not, check to see that Telephone EE–8–( ) is functioning properly (TM 11–333). Check the wiring from L1 and L2, through ORDER WIRE switch S5, to terminal points E5 and E6 (fig. 43).

c. Measure the voltage across terminal points E5 and E6 with Electronic Multimeter ME–6/U;

connect the ground side of ME–6/U to E6. The reading should be approximately 45 volts. If trouble is indicated, check the wiring through the ORDER WIRE switch and check resistor R32 and varistors CR1 through CR5.

d. Use Multimeter TS–352/U (set on the 50-volt range) to measure the d-c voltage from the points indicated in the table below and chassis terminal point E10. The negative side of meter M1 is connected to terminal E10 for all these measurements. The following table lists the typical voltages to be expected and the corrective measures to be applied if trouble is indicated.

Measuring points	Typical volts (dc)	Corrective measures
Chassis terminal E4	39	Check CR1, CR2, CR3, CR4, C16, C17, C18, C19, C20, C21, C22, R31, and R30 (fig. 43).
Junction of R39 and C24.	23	Check R29, R30, R31, C22, C23, C24, R28, R27, and Q1.
Terminal 1 of T2	23	Check R30 and C22.
Junction of R27 and Q1.	22	Check R27 and Q1.

e. Use Electronic Multimeter ME–6/U to measure the 1,600-cycle voltage across the points indicated in the table below. The table lists the typical voltages to be expected and the corrective measures to be applied if trouble is indicated.

Measuring points	Typical volts (ac)	Corrective measures
Terminals 2 and 1 of T2 (gnd side to 1).	4	Check Q1, R26, T2, C12, C13, C14, C15, C11, and R25 (fig. 43).
Terminals 3 and 1 of T3 (gnd side to 1).	1.3	Check R23, R24, R25 and T3. Check wiring through ORDER WIRE switch S5.
Terminal 6 of T3 and terminal M of connector P1 (gnd side to M).	1.1	Check T3, R33, and R38. Also check wiring through OW GAIN switch S6 (HIGH position).
Terminals L and M of connector P1 (gnd side to M).	.17 to .775	Check R33, R38, and C3.

135. Artificial Cable Z1, Signal Substitution Test

Follow the procedure below to check the operation of artificial cable Z1. To make this test, connect the equipment in accordance with the instructions in paragraph 132*c* and proceed as follows:

a. Connect point A to point C and point B to point D (fig. 38).

(1) Operate Signal Generator SG–71/FCC to deliver a 12-kc signal frequency.

(2) Adjust the SG–71/FCC output control for a reading of 18 db on Electronic Multimeter ME–6/U (set on the 1-volt range) connected as shown in figure 38.

(3) Remove the ME–6/U and the connections between points A and C, and between points B and D.

b. Connect points A, B, C, and D to the transmission test-cable assembly as follows:

(1) Connect point A to terminal 1.

(2) Connect point B to terminal 2.

(3) Connect point C to terminal 3.

(4) Connect point D to terminal 4.

c. Connect connector (Z1) P1 of artificial cable Z1 to the transmission test-cable assembly.

d. Connect Electronic Multimeter ME–6/U to terminals 1 and 2 on cable-simulating network (Z1) Z1 (ground side of the ME–6/U to terminal 2). The cover plate must be removed from artificial cable Z1 so that these terminals may be reached (fig. 23). Electronic Multimeter ME–6/U reading should be 1.3 volts. If trouble is indicated, check transformer (Z1) T1 and cable-simulating network (Z1) Z1.

e. Connect Electronic Multimeter ME–6/U to terminals 3 and 4 on cable-simulating network (Z1) Z1 (ground side of the ME–6/U to terminal 4). Electronic Multimeter ME–6/U reading should be .3 volt. If trouble is indicated, check transformer (Z1) T2, cable-simulating network (Z1) Z1, and resistor (Z1) R1.

f. Connect the ME–6/U as shown in figure 38. Electronic Multimeter ME–6/U should read 2.4 ±1.5 db on the 1-volt range. If trouble is indicated, check transformer (Z1) T2.

g. Repeat *a* above for a signal generator frequency of 68 kc.

h. Repeat *b* and *c* above.

i. Repeat *d* above for the 68-kc frequency. The meter reading should be 1.3 volts. The corrective measures are the same as those outlined in *d* above.

j. Repeat *e* above for the 68-kc frequency. The meter reading should be .13 volt. The corrective measures are the same as those outlined in *e* above.

k. Repeat *f* above for the 68-kc frequency. The meter reading should be 15.1 ±1.5 db on the 1-volt range. The corrective measure is the same as indicated in *f* above.

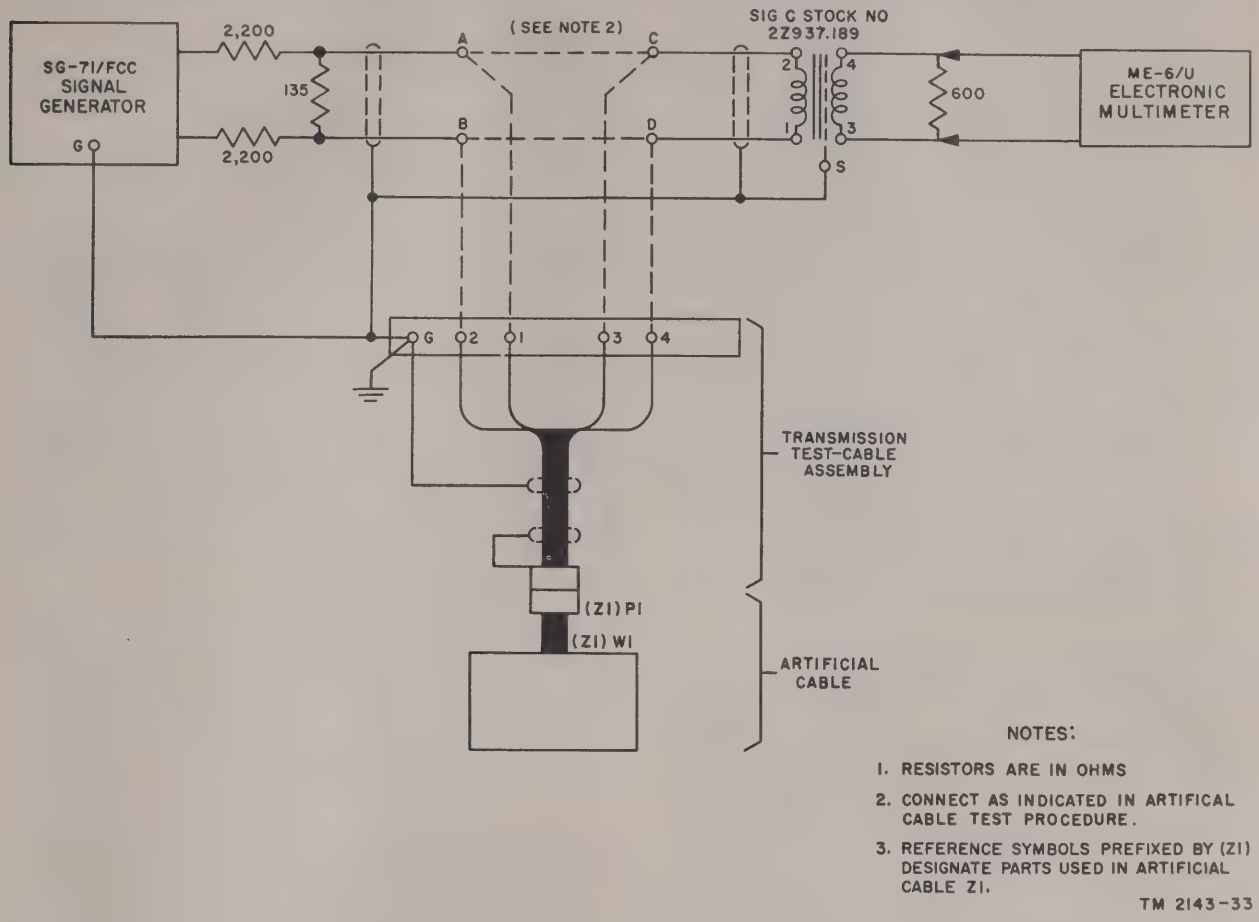


Figure 38. Telephone Test Set TS–712/TCC–11, artificial cable Z1 test setup.

Section II. REPAIRS

136. Replacement of Parts

a. General. Most parts on Telephone Test Set TS–712/TCC–11 are readily accessible and are replaced easily. Figures 32 through 36 show the location of the individual parts. Refer to these figures when parts require replacement and to the general precautions outlined in paragraph 114. When replacing parts, proceed as follows:

(1) Remove the cover from the carrying case by loosening the carrying strap and opening the snap catches (fig. 2).

(2) Remove the TS–712 test set chassis from the carrying case by removing the four screws and washers from the top panel (fig. 3).

(3) The bottom of the chassis of the TS–712 test set is hinged so that the chassis can be folded back to expose the removable parts on the chassis. Remove the two screws which hold the bottom chassis to the two channels at the end of the top panel farthest from the meter, and pull the bottom chassis back on its hinges. In this way, the wiring side of the top panel and the apparatus side of the bottom chassis is exposed.

b. Removal of Switches. If a switch requires replacement, mark the wires connected to the switch carefully with tags or other devices to avoid misconnection when the new switch is in-

stalled. Follow this practice whenever replacement requires the disconnection of numerous wires.

137. Refinishing at Field Maintenance Level

Instructions for refinishing badly marred panels or exterior cabinets are given in TM 9–2851. Rustproofing instructions for metal parts are given in TB SIG 23.

138. Lubrication of Equipment

Lubrication of the TS–712 test set is not required. All moving parts are inclosed within a watertight seal.

Section III. ALINEMENT PROCEDURES

139. Alinement Procedures, General

Paragraphs 142 through 144 describe the alinement procedures for the TS–712 test set. The troubleshooting chart (par. 117) should be consulted if any trouble is encountered in making the adjustments for alinement. Test equipment required for alinement is listed in paragraph 140. The setup used for alinement is described in paragraph 141.

140. Tools and Test Equipment Required for Alinement

The test equipment required for alinement and adjustment is listed in the table below.

Test equipment	Technical manual	No. reqd.
Attenuator TS–402/U or equal.	TM 11–2044	1
Clips, alligator		2
Electronic Multimeter ME–6A/U or equal.	TM 11–5549	1
Frequency Meter FR–67/U or equal.	TM 11–2698	1
Multimeter TS–352/U or equal.	TM 11–5527	1
Resistor, 135-ohm, ±1%, ½ watt, Sig C stock No. 3Z6013E5–6.		1
Resistor, 600-ohm, ±1%, ½ watt, Sig C stock No. 3Z6060–119.		2
Resistor, 680-ohm, ±5%, ½ watt, Sig C stock No. 3RC20BF681J.		1
Resistor, 2,200-ohm ±5%, ½ watt, Sig C stock No. 3RC20BF222J.		2
Resistor, 12,000-ohm ±1%, ½ watt, Sig C stock No. 3Z6612–85.		1
Signal Generator SG–71/FCC or equal.		1
Supply test-cable assembly (fig. 24).		1
Telephone jack Sig C stock No. 2Z5533.		1
Telephone plug Sig C stock No. 2Z7228A–309.		
Telephone EE–8–( )	TM 11–333	1
Transformer Sig C stock No. 2Z9637.189.		1

141. Alinement Procedure Setup

Connect the equipment as indicated below to make an alinement test on the TS–712 test set.

a. Arrange the equipment as shown in B, figure 26 to supply terminating resistors to the TS–712 test set. This arrangement also makes the terminals of connector P1 available as connection points on the supply test-cable assembly. The 1.5-volt battery and the adjustable power supply connections are not required for these tests.

b. Arrange the equipment as shown in A, figure 26 as a source of test-signal power. Set the test-signal frequency and output to the specified values (before connection is made to the TS–712 test set) as follows:

(1) Set Signal Generator SG–71/FCC frequency output within the limits required in the following tests; use Frequency Meter FR–67/U for checking the frequency. Connect Frequency Meter FR–67/U at the points indicated in figure 26.

(2) With the TS–402/U set for 0 db, adjust the SG–71/FCC output control for the specified voltage in the tests below as indicated on the Electronic Multimeter ME–6/U connected as shown in figure 26.

(3) Set the TS–402/U to the number of db specified in the procedures in paragraphs 142, 143, and 144.

c. All adjustments must be made with the TS–712 test set removed from its carrying case.

d. Power is supplied to the transmission test circuit of the TS–712 test set by the plug-in batteries BT1 and BT2. Check to see that these batteries are connected before proceeding with the tests.

e. Make the adjustments in the sequence given. At each step in each procedure, it is assumed that all previous steps were completed satisfactorily.

f. After a TS–712 test set has been alined, it should be tested completely in accordance with instructions in paragraph 145 to insure that all circuits are functioning properly.

142. Voltage Alinement Procedure, TS–712 Test Set

Follow the procedure below to adjust the A and B voltages of the TS–712 test set.

a. Adjust the position of the TS–712 test set meter pointer as follows:

(1) Make sure the POWER switch is at the off position.

(2) Turn the adjustment screw on the front of the meter until the needle rests on the mark at the extreme left side of the meter scale.

b. Operate the POWER switch to the ON position and the MEASURE switch to the A BAT position. Adjust the A BAT control so that the meter reads at the BAT mark.

c. Operate the MEASURE switch to the B BAT position. Adjust the B BAT control so that the meter reads at the BAT mark.

d. Check these adjustments from time to time during the following tests. Allow a warmup period of at least 10 minutes before proceeding with the alinement.

143. Transmission Test Circuit Alinement Procedure

The purpose of the following procedure is to adjust the transmission test circuit of the TS–712 test set. To make this adjustment, use the procedures outlined in paragraphs 141 and 142, and proceed as follows:

a. Operate the MEASURE switch to the TRANS position and the SELECTOR switch to the AMP 1 IN 68 KC position.

b. Use the test arrangement shown in figure 26. Set the frequency of Signal Generator SG–71/FCC to 68 kc ±3 cycles; check the output with Frequency Meter FR–67/U. With no connection to the test jack and with Attenuator TS–402/U at a 0-db loss, adjust Signal Generator SG–71/FCC output control for a reading of .775 volt on Electronic Multimeter ME–6/U connected as shown in figure 26.

c. Connect the ground clip of the test cord (fig. 26) to terminal M of the supply test-cable assembly (fig. 24) and the test clip to terminal A. Set Attenuator TS–402/U to 23 db and insert the plug of the test cord in the test jack.

d. Adjust the GAIN control for a meter reading of approximately 0 db.

e. Adjust capacitor C7 for a maximum meter reading (fig. 43). Adjust the GAIN control for a meter reading of 0 db. Remove the plug of the test cord from the test jack (fig. 26).

f. Set the frequency of Signal Generator SG–71/FCC to 1 kc ±20 cycles; check the output frequency with Frequency Meter FR–67/U. With no connection to the test jack and with Attenuator TS–402/U set at 0 db, adjust Signal Generator SG–71/FCC output control for a reading of .775 volt on Electronic Multimeter ME–6/U, connected as shown in figure 26.

g. Set Attenuator TS–402/U to 8 db. Operate the SELECTOR switch to the AMP 1 IN 1 KC position, and insert the plug of the test cord in the test jack.

h. Remove the locking nut from control R8 and adjust control R8 until meter M1 reads 0 db (fig. 43). Replace the locking nut on R8. Remove the test cord connections from the supply test-cable assembly (fig. 26).

144. Oscillator Q1 Frequency Alinement Procedure

(fig. 26)

The purpose of the following procedure is to aline the oscillator frequency. To make this adjustment, follow the procedures outlined in paragraphs 141 through 143, and in *a* and *b* below:

a. Connect Frequency Meter FR–67/U to terminals L and M of the supply test-cable assembly; use terminal M as the ground terminal. Connect Telephone EE–8–( ) to terminals L1 and L2 of the TS–712 test set.

b. Turn the handcrank of Telephone EE–8–( ) at normal speed (200 rpm) and adjust capacitor C15 (fig. 43) for a frequency of 1,600 ±1 cycle as indicated on Frequency Meter FR–67/U. If this cannot be done, some arrangement of capacitors C12, C13, and C14 should be found for which the proper frequency can be obtained. The following arrangements of capacitors C12, C13, and C14 should be tried:

(1) None.
(2) C12.
(3) C14.
(4) C12 and C14.
(5) C13 and C14.
(6) C12, C13, and C14.

145. General

This section is intended as a guide to be used in determining the quality of a repaired TS–712 test set. The procedures outlined in paragraphs 147 through 155 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation. Tools and test equipment required for final tests are listed in paragraph 146. Specific tests are listed below:

a. Final test setup (par. 147).
b. MEASURE switch test (par. 148).
c. GAIN control range test (par. 149).
d. Meter scale test (par. 150).
e. Transmission test circuit sensitivity test (par. 151).
f. 1,600-cycle oscillator test (par. 152).
g. Order-wire pads test (par. 153).
h. Insulation test (par. 154).
i. Artificial cable test (par. 155).

Note. Before making the final tests, use the alinement procedures of paragraphs 141 through 144.

146. Tools and Test Equipment Required for Final Test

Test equipment required for the final tests is listed in the table below.

Test equipment	Technical manual	No. Reqd.
Attenuator TS–402/U or equal	TM 11–2044	1
Clips, alligator		2
Electronic Multimeter ME–6A/U or equal.	TM 11–5549	1
Frequency Meter FR–67/U or equal.	TM 11–2698	1
Multimeter TS–352/U or equal.	TM 11–5527	1
Power supply, 135–160 volts dc, adjustable, 2 ma.		1
Resistor, 135 ohms, ±1% ½ watt, Sig C stock No. 3Z6013E5–6.		1
Resistor, 600 ohms, ±1% ½ watt, Sig C stock No. 3Z6060–119.		2
Resistor, 680 ohms, ±1% ½ watt, Sig C stock No. 3RC20BF681J.		1
Resistor, 2,200 ohms, ±5% ½ watt, Sig C stock No. 3RC20BF222J.		2
Resistor, 12K ohms, ±1%, ½ watt, Sig C stock No. 3Z6612–85.		1
Resistor, 15K ohms, ±10%, ½ watt, Sig C stock No. 3RC20BF153J.		1
Resistor, variable, 15K ohms, ±20%, 2 watts, Sig C stock No. 3Z7415–41.		1
Signal Generator SG–71/FCC or equal.		1
Supply test-cable assembly (fig. 24).		1
1½-volt battery		1
Telephone jack, Sig C stock No. 2Z5533.		1
Telephone plug Sig C stock No. 2Z7228A–309.		1
Transformer Sig C stock No. 2Z9637.189.		1
Transmission test-cable assembly (fig. 25).		1

147. Final Test Setup and Test Procedures

The purpose of the final test setup is to prepare the TS–712 test set for the final tests (pars. 148 through 155). The final tests must be made in the sequence given.

a. Arrange the equipment as shown in B, figure 26, to supply resistor terminations and power to the TS–712 test set. This also makes the terminals of connector P1 available as test points on the supply test-cable assembly.

b. Arrange the equipment as shown in A, figure 26, as a source of test-signal power for tests on the transmission test circuit of the TS–712 test set.

(1) When the procedures call for a test frequency within definite limits, Signal Generator SG–71/FCC should be set within the limits required; use Frequency Meter FR–67/U for checking the frequency. The FR–67/U should be connected at the points indicated in figure 26.

(2) The test signal output at the test jack (fig. 26) should be set to the specified value before a connection is made to the test jack. With Attenuator TS–402/U set for 0 db, adjust Signal Generator SG–71/FCC output control for the voltage specified in the final tests. Measure

the SG–71/FCC output with Electronic Multimeter ME–6/U. Then set the TS–402/U to the number of db specified in the test. Connect the test and ground clips of the test cord as required, and insert the plug of the test cord in the test jack.

c. Arrange the equipment as shown in figure 27 to supply test signals for tests on the order-wire pads.

d. Arrange the equipment as shown in figure 38 for testing artificial cable Z1.

e. Power is supplied to the transmission test circuit of the TS–712 test set by batteries BT1 and BT2 (fig. 43). Check to see that these batteries are connected before beginning the tests.

f. Adjust the A and B batteries in accordance with the instructions in paragraph 142.

g. Make all tests with the TS–712 test set removed from its carrying case.

h. Make the tests in the sequence given. At each step in each procedure, it is assumed that all previous steps were completed satisfactorily.

148. MEASURE Switch of TS–712 Test Set, Final Test

(fig. 26)

The purpose of this test is to check the operation of the MEASURE switch. To make this test, set up the equipment as indicated in figure 26 and proceed as follows:

a. Operate the MEASURE switch to the A BAT position. Connect Multimeter TS–352/U (arranged for a d-c voltage measurement on the 2.5-volt range) across terminals 7 and 1 of tube V1 (fig. 43). Adjust the A BAT control for a TS–712 test set meter reading at the BAT mark. The reading on Multimeter TS–352/U should be 1.2 ±.1 volt. Disconnect Multimeter TS–352/U from the TS–712 test set.

b. Operate the MEASURE switch to the B BAT position. Connect Multimeter TS–352/U (arranged for d-c voltage measurement on the 250-volt range) across terminals 3 and 1 of tube V1 (terminal 3 is the positive terminal). Adjust the B BAT control for a TS–712 test set meter reading at the BAT mark. The reading on Multimeter TS–352/U should be 67 ±10 volts. Disconnect Multimeter TS–352/U from the TS–712 test set.

c. Operate the MEASURE switch to the REP VOLTS position. Connect Multimeter TS–352/U (arranged for a d-c voltage measurement on the 250-volt range) across the power supply as shown in B, figure 26. Adjust the power supply voltage for a TS–712 test set meter (M1) reading at the BAT mark. The reading on Multimeter TS–352/U should be 148 ±15 volts. Turn off the adjustable power supply and remove Multimeter TS–352/U connections from it.

d. Connect Multimeter TS–352/U (arranged as an ohmmeter) across terminals H and M of the supply test-cable assembly (fig. 26). Operate the V ACT switch to the TEST position. Multimeter TS–352/U should read 0 ohms. Release the V ACT switch and disconnect Multimeter TS–352/U from the supply-test cable assembly.

e. Check to see that the variable resistor shown in figure 26 is set at its maximum resistance position. Connect the positive side of Multimeter TS–352/U (arranged to measure a direct current on the 250-microampere range) to the variable resistor (fig. 24). Connect the negative side of the TS–352/U to terminal B on the supply test-cable assembly. Operate the MEASURE switch to the V1 AMP 1 position and adjust the variable resistor (fig. 26) for a TS–712 test set reading at the BAT mark. Multimeter TS–352/U should read 66 ±10 microamperes. Then operate the MEASURE switch to the V2 AMP 1, V1 AMP 2, and V2 AMP 2 positions. There should be no meter reading on the TS–712 test set meter or Multimeter TS–352/U for these three positions of the MEASURE switch.

f. Connect the negative side of Multimeter TS–352/U to terminal K of the supply test-cable assembly. Operate the MEASURE switch to the V2 AMP 1 position. The TS–712 test set meter should read at the BAT mark. Operate the MEASURE switch to the V1 AMP 1, V1 AMP 2, and V2 AMP 2 positions. There should be no meter readings for these three positions of the MEASURE switch.

g. Connect the negative side of Multimeter TS–352/U to terminal F of the supply test-cable assembly. Operate the MEASURE switch to the V1 AMP 2 position. The TS–712 test set meter should read at the BAT mark. Operate the MEASURE switch to the V1 AMP 1, V2 AMP 1, and V2 AMP 2 positions. There should be no meter readings for these three positions of the MEASURE switch.

h. Connect the negative side of Multimeter TS–352/U to terminal P of the supply test-cable assembly. Operate the MEASURE switch to the V AMP 2 position. The TS–712 test set meter

should read at the BAT mark. Operate the MEASURE switch to the V1 AMP 1, V2 AMP 1, and V1 AMP 2 positions. There should be no meter readings for these three positions of the MEASURE switch. Disconnect Multimeter TS–352/U.

149. GAIN Control Range, Final Test

The purpose of this final test is to check the GAIN control range. To make this test, proceed as follows:

a. Adjust the batteries in accordance with paragraph2. 14

b. Connect the test equipment as shown in figure 26. Set the frequency of Signal Generator SG–71/FCC to 68 kc ±100 cycles; check this frequency with Frequency Meter FR–67/U. With no connection to the test jack and with Attenuator TS–402/U set at 0 db, adjust Signal Generator SG–71/FCC output control for a reading of .775 volt with Electronic Multimeter ME–6/U connected as shown in figure 26.

c. Connect the ground clip of the test cord to terminal M of the supply test-cable assembly and the test clip to terminal A. Set Attenuator TS–402/U to 23 db, and insert the plug of the test cord in the test jack.

d. Operate the MEASURE switch to the TRANS position, the SELECTOR switch to the AMP 1 IN 68 KC position, and adjust the GAIN control to its maximum clockwise position. The TS–712 test set meter reading should be +3 db or more.

e. Adjust the GAIN control to its maximum counterclockwise position. The TS–712 test set meter reading should be −5 db or less.

f. Adjust the GAIN control for a 0-db meter reading before proceeding with the tests outlined in paragraphs 150 through 155.

150. Meter Scale, Final Test

The purpose of this test is to check the accuracy of the meter scale. To make this test, proceed as follows:

a. Check to see that the test signal setup of A, figure 26 is connected, and that the TS–712 test set is adjusted as described in paragraph 149.

b. Operate Attenuator TS–402/U to the db settings shown in the first column of the table below. At each setting, the TS–712 test set meter reading should be within the limits indicated in the second column.

Attenuator TS–402/U setting (db)	TS–712 test set meter readings (db)
16	+7 ±1
17	+6 ±1
18	+5 ±1
19	+4 ±1
20	+3 ±1
21	+2 ±1
22	+1 ±1
23	0
24	−1 ±1
25	−2 ±1
26	−3 ±1
27	−4 ±1
28	−5 ±1

151. Transmission Test Circuit Sensitivity, Final Test

The purpose of this test is to check the sensitivity of the transmission test circuit. To make this test, proceed as follows:

a. Arrange the equipment as shown in A, figure 26. For each position of the SELECTOR switch listed in the table in *b* below, use the following procedure:

(1) Set the SELECTOR switch to the required position.

(2) Connect the test clip of the test cord shown in figure 26 to the corresponding terminal on the supply test-cable assembly as given in the table in *b* below. Connect the ground clip of the test cord to terminal M of the test-cable assembly for all these tests.

(3) Adjust the frequency of Signal Generator SG–71/FCC (checked with Frequency Meter FR–67/U) as indicated in the table (*b* below).

(4) With 0-db loss in Attenuator TS–402/U, adjust the output of the SG–71/FCC for .775 volt as read on Electronic Multimeter ME–6/U (connected as shown in figure 26).

(5) Set Attenuator TS–402/U for the db loss as determined in the table (*b* below).

(6) Insert the test cord in the test jack (fig. 26).

(7) The TS–712 test set meter reading should be within the limits given in the table.

(8) Repeat this procedure for each position of the SELECTOR switch.

b. The SELECTOR switch sensitivity table follows:

SELECTOR switch positions	Test clip of test cord to terminal	Test signal frequency (SG–71/FCC)	Attenuator TS–402/U setting (db)	TS–712 test set meter reading (db)
AMP 1 IN 68 KC	A	68 kc ±100 cyc	23	0±.2
AMP 2 IN 68 KC	R	68 kc ±100 cyc	23	0±.3
AMP 1 OUT 68 KC	C	68 kc ±100 cyc	0	0±.5
AMP 2 OUT 68 KC	E	68 kc ±100 cyc	0	0±.5
AMP 1 IN 1 KC	A	1 kc ±20 cyc	8	0±.4
AMP 1 OUT 1 KC	C	1 kc ±20 cyc	8	0±.5
AMP 2 IN 1 KC	R	1 kc ±20 cyc	8	0±.5
AMP 2 OUT 1 KC	E	1 kc ±20 cyc	8	0±.5

c. Connect the test clip of the test cord to terminal E of the supply test-cable assembly and the ground clip to terminal M. Connect Electronic Multimeter ME–6/U (set on the 1-volt range) across terminals 1 and 2 of filter FL2 (fig. 43, terminal 2 is ground). Operate the SELECTOR switch to the AMP 2 OUT 1 KC position. Adjust Signal Generator SG–71/FCC frequency output to 1 kc ±20 cycles; check this frequency with Frequency Meter FR–67/U. Insert the plug of the test cord in the test jack, set Attenuator TS–402/U to 0 db, and adjust Signal Generator SG–71/FCC output control for a reading of 10 db on Electronic Multimeter ME–6/U. Operate the 1 KC SENS switch to the LOW position and change the setting of Electronic Multimeter ME–6/U to the .1-volt scale. Electronic Multimeter ME–6/U should read 10 ±1db. Disconnect the test cord and Electronic Multimeter ME–6/U and release the 1 KC SENS switch.

152. Oscillator Q1, Final Test

(fig. 26)

The purpose of this test is to check 1,600-cycle oscillator Q1. To make this test, proceed as follows:

a. Connect Telephone EE–8–( ) to binding posts L1 and L2 of the TS–712 test set. Operate the OW GAIN switch to the HIGH position and the ORDER WIRE switch to the RING position. Connect Frequency Meter FR–67/U to terminals L and M of the supply test,cable assembly (M is the negative side). Turn the handcrank of the Telephone EE–8–( ) at a normal speed (200 rpm). Frequency Meter FR–67/U should read 1,600 ±5 cycles.

b. Disconnect Frequency Meter FR–67/U and connect Electronic Multimeter ME–6/U to terminals L and M of the supply test-cable assembly (ground to terminal M). Turn the handcrank of Telephone EE–8–( ) at normal speed. Electronic Multimeter ME–6/U should read between .170 and .775 volt.

153. Order-Wire Pads, Final Test

The purpose of this test is to check the order-wire pads. To make this test, proceed as follows:

a. Arrange the equipment as shown in figure 27. Set the frequency output of Signal Generator SG–71/FCC to 1,000 cycles. Connect the 600-ohm resistor across the binding posts of Electronic Multimeter ME–6/U. Also, connect the A and B leads (fig. 27) to the binding posts of Electronic Multimeter ME–6/U. Adjust Signal Generator SG–71/FCC output control for a reading of 14 db on the 1-volt range of Electronic Multimeter ME–6/U. Remove the A and B leads from Electronic Multimeter ME–6/U. Do not disturb Signal Generator SG–71/FCC adjustments for the remainder of this procedure.

b. Connect the A and B leads to binding posts L1 and L2 of the TS–712 test set. Operate the ORDER WIRE switch to the TALK position. For each position of the OW GAIN switch listed in the table below, measure the voltage at the indicated terminals (terminal M is ground) with Electronic Multimeter ME–6/U. The readings should meet the requirements given in the table below.

OW GAIN switch position	Electronic Multimeter ME–6/U connected to the supply-test cable assembly	Electronic Multimeter ME–6/U reading	
		Scale	Readings (db)
LOW	L and M	0.1	13.5±1.5
MED	L and M	1	1.7±1.5
WIGH	L and M	1	7.5±1.5
LOW	N and M	.1	1.5±1.5
MED	N and M	.1	10.2±1.5
HIGH	N and M	1	2.1±1.5

154. Insulation of TS–712 Test Set, Final Test

(fig. 26)

The purpose of this test is to check the insulation of the TS–712 test set. To make this test, proceed as follows:

a. Remove all connections from terminals C, A, E, R, M, L, N, and D of the supply test-cable assembly (fig. 26). Measure the resistance between terminal D and each of the terminals listed below with the SELECTOR switch in the position listed. Use Multimeter TS–352/U set for ohms. Each resistance measured should be 1 megohm or more.

b. The insulation test table follows:

Terminal	SELECTOR switch position
C	AMP 1 OUT 1 KC.
A	AMP 1 IN 1 KC.
E	AMP 2 OUT 1 KC.
R	AMP 2 IN 1 KC.
M	Any position.
L	Any position.
N	Any position.

155. Artificial Cable, Final Test

The purpose of this test is to check the operation of artificial cable Z1. To make this test, proceed as follows:

a. Connect the equipments as shown in figure 38. Connect point A to point C and point B to point D. Set the frequency output of Signal Generator SG–71/FCC to 12 kc. Adjust Signal Generator SG–71/FCC output control for a reading of 18 db on the 1-volt range of Electronic Multimeter ME–6/U (connected as shown in figure 38). Remove the connections from point A to point C and from point B to point D.

b. Connect the terminals on the terminal board associated with the transmission test-cable assembly to the A, B, C, and D points shown in figure 38 as follows: 1 to A, 2 to B, 3 to C, and 4 to D. Electronic Multimeter ME–6/U should read 2.4±1.5 db on the 1-volt range.

c. Repeat *a* and *b* above with Signal Generator SG–71/FCC frequency output set to 68 kc. Electronic Multimeter ME–6/U reading (for the test outlined in *b* above) should be 15.1±1.5 db on the .1-volt range.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

156. Disassembly

The following instructions are recommended as a guide for preparing Telephone Test Set TS–712/TCC–11 for transportation and storage.

a. Remove batteries BT1 and BT2 from the TS–712 test set by reversing the procedure of *a* through *j* of paragraph 16.

b. Fasten connector P1 to the connector holder on the top panel with the wing screw.

c. Replace the cover. Fasten the snap catches and tighten the carrying strap.

d. Thread the protective cap onto the artificial cable connector.

e. To remove the batteries from Telephone EE–8–( ), follow the instructions given in TM 11–333.

157. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 14 and reverse the instructions.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the cardboard cartons. Protect the crates with a waterproof tape barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected cartons in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

158. General

The demolition procedures outlined in paragraph 159 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

159. Methods of Destruction

a. Smash. Smash the controls, tubes, switches, capacitors, transformers, and filter networks; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords and wiring; use axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals; use gasoline, kerosene, oil, flamethrowers, or incendiary grenades.

d. Bend. Bend the ends of the assembly panel and the chassis.

e. Explode. If explosives are necessary, use firearms, grenades, or TNT.

f. Dispose. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check publications indexes in the SR 310–20–series of Special Regulations.

1. Army Regulations

AR 380–5	Safeguarding Security Information.
AR 750–5	Maintenance Responsibilities and Shop Operation.

2. Supply

SR 725–405–5	Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11–6	Dry Battery Supply Data.
SB 11–100	Serviceability Standards for Signal Equipment in Hands of troops.

3. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TM 9–2851	Painting Instructions for Field Use.

4. Camouflage, Decontamination, and Demolition

FM 5–20	Camouflage, Basic Principles.
FM 5–25	Explosives and Demolitions.
TM 3–220	Decontamination.

5. Other Publications

SR 310–20–7	Index of Tables of Organization and Equipment, Reduction Tables, Tables of Organization, Tables of Equipment Type Tables of Distribution, and Tables of Allowances.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbols CSGLD–247 (R1)).
SR–745–45–5 Navy Shipping Guide Article 1850–4 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), S and A–70–6 (Navy), and AF–MC–U2 (Air Force)).

5. Other Publications—Continued

TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TB SIG 223	Field Expedients for Wire and Radio.
TM 11–333	Telephones EE–8, EE–8–A, and EE–8–B.
TM 11–415	Dry Batteries.
TM 11–430	Batteries for Signal Communication, except those pertaining to aircraft.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11–681	Electrical Fundamentals (Alternating Current).
TM 11–2139	Telephone Terminal AN/TCC–7.
TM 11–2140	Telephone Repeater AN/TCC–8 and Telephone Repeater AN/TCC–21.
TM 11–2148	Telephone Repeater AN/TCC–11.
TM 11–2150	Telephone Carrier Systems Using Telephone Terminal AN/TCC–7, Telephone Repeater AN/TCC–8 (AN/TCC–21), Telephone Repeater AN/TCC–11, and Telephone Test Set TS–712/TCC–11.

6. Test Equipment References

TM 11–1209	Test Set I–157–A (Tube and Set Tester, Precision Model 920P).

6. Test Equipment References—Continued

TM 11–2044 Attenuators TS–402/U and TS–402A/U.

TM 11–2535 Meter Test Equipment AN/GSM–1.

TM 11–2535A Meter Test Equipment AN/GSM–1B.

TM 11–2626 Test Units I–176, I–176–A, and I–176–B.

TM 11–2627 Tube Testers I–177 and I–177–A.

TM 11–4700 Electrical Indicating and Measuring Instruments; Repair Instructions.

TM 11–5043 Analyzer ZM–3/U.

TM 11–5500 Multimeter TS–297/U.

TM 11–5527 Multimeter TS–352/U.

7. Test Equipment, Other Publications

TM 11–369 Spiral-Four Cable.

TM 11–372 Lead Sheath Telephone Cable Splicing.

TM 11–486 Electrical Communication Systems Engineering.

TM 11–664 Theory and Use of Electronic Test Equipment.

TM 11–676 Grounding Procedure and Protective Devices.

TM 11–678 Fundamentals of Telephony.

TM 11–757 Principles of Line Fault Location.

TM 11–2261 Telephone Outside Plant Engineering.

TM 11–2262 Open Wire Pole Line; Construction and Maintenance.

TM 11–2263 Lead-Covered Cable; Construction and Maintenance.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O & E, T/A, SIG 7 & 8, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Manual applicable to the equipment covered in this technical manual is SIG 7 & 8 TS–712/TCC–11. For an index of available supply manuals in the Signal portion of the Department of the Army Supply Manual, see SR 310–20–21.

1. Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712)

Figure reference	Name of part and description	Function of part	Signal Corps stock No.
3	TEST SET, telephone: main chassis; portable; internal battery source, 90 v; 8 9/16″ lg x 1 13/16″ wd x 3 21/64″ h (see par. 2 of this appendix for parts).	Used for transmission tests, and d-c voltage tests on the AN/TCC–11. Contains order-wire talk and ring circuits.	3F4325–712Z
4	LOAD, dummy electrical, Z1; c/o 1 cable assy, 1 network, 2 transformers; o/a dimen excluding cable assy, 8 9/16″ lg x 1 13/16″ wd x 3 21/64″ h (see par. 3 of this appendix for parts).	Used as artificial cable	2Z3904–17
5	TELEPHONE EE–8–( ): sealed set; self-contained (see TM 11–333).	Used to communicate over order-wire circuit and to provide power to transistor oscillator in the TS–712 test set.	4B5008

2. Main Chassis, Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712Z)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ARRESTOR, lightning: carbon block type; 500 v peak break-down v; 350 v rms line to grd; single cont bayonet base.	Used as spares for repeater AN/TCC–11.	3Z75–6.1
	ARRESTOR, lightning: carbon block type; 800 v peak break-down v; 565 v rms line to grd; single cont bayonet base.	Used as protector block spares for repeater AN/TCC–11.	3Z75–6.2
BT1	BATTERY, dry: 1.5 v nom v; 8 cont; lead; 2 cells.	Provides power for test set	3A275–402
BT2	BATTERY, dry: 90 v, tapped at 22.5 v, 45 v, and 67.5 v; 8 cont; lead; 60 cells.	Provides power for test set	3A275–415
	CABLE, special purpose: electrical; 14 cond, tinned copper, #22 AWG, stranded; natural rubber latex ins.	Used as part of cable assembly W1	1B3022–14
C12	CAPACITOR, fixed: mica dielectric; 91 μμf ±2%; 500 vdcw.	Tunes transformer T2 inductance	3K2091033
C13, C14	CAPACITOR, fixed: mica dielectric; 180 μμf ±2%; 500 vdcw.	Tunes transformer T2 inductance	3K2018133
C11	CAPACITOR, fixed: mica dielectric; 6800 μμf ±2%; 500 vdcw.	Tunes transformer T2 inductance	3K3568253
C9	CAPACITOR, fixed: mica dielectric; 10,000 μμf ±20%; 500 vdcw.	Couples V1 output to V2 control grid.	3K3510354

2. Main Chassis, Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712Z)—Con.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C1, C2, C5, C6	CAPACITOR, fixed: paper dielectric; 1 sect; 22,000 μμf ±20%; 600 vdcw; HS in metal can.	Block d-c voltages from V1 control grid.	3DA22–33
C8	CAPACITOR, fixed: paper dielectric; 1 sect; 68,000 μμf ±10%; 600 vdcw; HS in metal can.	Places one side of order-wire line at a-c ground potential.	3DA68–9
C3, C4	CAPACITOR, fixed: paper dielectric; 1 sect; 470,000 μμf ±10%; 600 vdcw; HS in metal can.	Used as d-c blocking capacitors	3DA470–42
C10	CAPACITOR, fixed: paper dielectric; 1 sect; 1 μf ±20%; 100 vdcw; HS in metal can.	Filters a-c voltages around battery supply.	3DB1–432
C16 through C24	CAPACITOR, fixed: paper dielectric; 1 sect; 1 μf ±20%; 100 vdcw; HS in metal can.	Filter rectifier outputs	3DB1–435
C7	CAPACITOR, variable: ceramic dielectric; 1 sect; 7–45 μμf capacitance; scdr slot adj.	Tunes filter FL1	3D9045V–15
C15	CAPACITOR, variable: ceramic dielectric; 1 sect; 20–125 μμf capacitance; 600 vdcw.	Tunes transformer T2 (adjusted during manufacture).	3D9125–10
P1	CONNECTOR, plug: 14 male round cont; pol; .620″ dia max cable size.	Provides electrical connection	2Z3034–2
P3	CONNECTOR, plug: 8 male round cont; pol; straight type; 1.25″ lg x 1.26″ dia.	Provides for connection to battery	2Z3028–87
P2	CONNECTOR, plug: 8 male round cont; pol; straight type; 1.25″ lg x 1.26″ dia.	Provides for connections to battery	2Z3028–83
	CONNECTOR, plug: 1 male round cont; straight type; 1⅛″ lg x ¼″ dia.	Provides for electrical contact to terminal board.	2Z3021–320
	COVER, test set: aluminum; zinc chromate, olive drab semigloss enamel; 13⅜″ lg x 10⅛″ wd x 4⅝″ d.	Covers Telephone Test Set TS–712/TCC–11 case.	3F30850–1
Q1	CRYSTAL UNIT, amplifying: germanium; metallic shell; collector, −100 v, −15 ma, 200 mw; emitter, −40 v, +15 ma.	Used as order-wire oscillator	2J2N21
CR1, CR2, CR3, CR4.	CRYSTAL UNIT, rectifying: germanium; .030 amp max continuous forward cur; .090 amp max peak forward cur; 125 v peak inverse v; ½″ lg x ¼″ dia.	Rectifies a-c voltage to d-c voltage	2J1N70
V1, V2	ELECTRON TUBE: pentode, diode; type 1U5.	V1: Amplifies a-c voltage V2: Amplifies and detects a-c voltage.	2J1U5
	FASTENER, latch: draw, pull catch type; steel, semigloss olive drab finish; 2$\frac{3}{32}$″ lg x 1⅜″ wd x $\frac{9}{16}$″ thk o/a.	Secures cover to case	6Z3810–115
FL2	FILTER, band-pass: 1.3 kc oper freq, 1–1.6-kc bandwidth; 600 ohms input, .15 meg output; moisture resistant.	Used as 1-kc band-pass filter	3Z1892–1.84
FL1	FILTER, band-pass: 68-kc oper freq; 3-kc bandwidth; 600 ohms input, .225 meg output.	Used as 68-kc band-pass filter	3Z1892–1.85
	GASKET: neoprene; 5 holes; 1⅛″ lg x 1⅛″ wd.	Used for case assembly	2Z4867.1068
	GASKET: neoprene; 4 holes; circular, 3½″ OD x 2.820″ ID x $\frac{1}{16}$″ thk.	Used as mounting gasket for meter	2Z4866.655

2. Main Chassis, Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712Z)—Cont.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
FL1—Continued	HOLDER, lightning arrestor: plug type; brass cont, pressure type; 1 5/32″ lg x 2 3/32″ dia.	Mounts protector block spares for repeater AN/TCC–11.	3Z3344–1
	KNOB: round; black plastic; for ¼″ dia shaft; ⅝″ dia x 7/16″ thk o/a.	Facilitates operation of control	
	KNOB: pointed bar; bakelite; black; 1 15/32″ lg x ¾″ wd x 2 1/32″ thk; luminous filled groove.	Facilitates operation of control	2Z5822–506
M1	METER: arbitrary scale: panel mtd; d-c operated; marked DB, −12,0, +8 cw; graduated logarithmically; body 2.80″ dia, 2.51″ max; ±2% accuracy at full-scale readings; 1,000 ±50 ohms across term., 100 ua, full-scale deflection.	Used as a multipurpose measuring scale.	3F3312–6.10
E1, E2	POST, binding: brass, silver coated; 5/64″ max dia of wire hole.	Provide for electrical connection to equipment.	3Z741–18.2
R27	RESISTOR, fixed: comp; 100 ohms ±5%; ½ w; JAN No. RC20BF101J.	Develops positive feedback voltage in transistor oscillator.	3RC20BF101J
R23, R25	RESISTOR, fixed: comp; 330 ohms ±5%; ½ w; JAN No. RC20BF331J.	Used as part of output pad for transistor oscillator.	3RC20BF331J
R24	RESISTOR, fixed: comp; 360 ohms ±5%; ½ w; JAN No. RC20BF361J.	Used as part of output pad for transistor oscillator.	3RC20BF361J
R33, R38	RESISTOR, fixed: comp; 430 ohms ±5%; ½ w; JAN No. RC20BF431J.	Used as part of order-wire pad	3RC20BF431J
R29	RESISTOR, fixed: comp; 620 ohms ±5%; ½ w; JAN No. RC20BF621J.	Develops transistor bias voltage	3RC20BF621J
R41	RESISTOR, fixed: comp; 820 ohms ±5%; ½ w; JAN No. RC20BF821J.	Used as part of order-wire pad	3RC20BF821J
R43	RESISTOR, fixed: comp; 910 ohms ±5%; ½ w; JAN No. RC20BF911J.	Used as part of order-wire pad	3RC20BF911J
R19	RESISTOR, fixed: WW; inductive wdg; 965 ohms ±1%; ⅓ w, JAN No. RB16E965R0F.	Used as part of meter pad to measure repeater voltage.	3RB4–9650.1
R16	RESISTOR, fixed: WW; inductive wdg; 1000 ohms ±1%; ⅓ w; JAN No. RB16E10000F.	Used as part of meter pad to measure plate supply voltage.	3RB5–1000.12
R30, R35	RESISTOR, fixed: comp; 1000 ohms ±5%; ½ w; JAN No. RC20BF102J.	R30: Filters output of bridge rectifier. R35: Used as part of order-wire pad.	3RC20BF102J
R26, R36	RESISTOR, fixed: comp; 1,200 ohms ±5%; ½ w; JAN No. RC20BF122J.	R26: Limits current in transistor emtter circuit. R36: Used as part of order-wire pad.	3RC20BF122J
R44	RESISTOR, fixed: comp; 1,300 ohms ±5%; ½ w; JAN No. RC20BF132J.	Used as part of order-wire pad	3RC20BF132J
R37	RESISTOR, fixed: comp; 1,600 ohms ±5%; ½ w; JAN No. RC20BF162J.	Used as part of order-wire pad	3RC20BF162J
R39	RESISTOR, fixed: comp; 1,800 ohms ±5%; ½ w; JAN No. RC20BF182J.	Used as part of order-wire pad	3RC20BF182J
R31	RESISTOR, fixed: comp; 2,400 ohms ±5%; ½ w; JAN No. RC20BF242J.	Filters output of bridge rectifier	3RC20BF242J
R2, R4	RESISTOR, fixed: film; 2,670 ohms ±1%; ½ w; deposited carbon.	Used as amplifier input pad resistors.	3Z6267–2
R5	RESISTOR, fixed: film; 3,360 ohms ±1%; ½ w; deposited carbon.	Used as amplifier input pad resistor.	3Z6336–1

2. Main Chassis, Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712Z)—Con.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R34, R45	RESISTOR, fixed: comp; 3,900 ohms ±5%; ½ w; JAN No. RC20BF392J.	Used as parts of order-wire pad	3RC20BF392J
R42	RESISTOR, fixed: comp; 5,100 ohms ±5%; ½ w; JAN No. RC20BF512J.	Used as part of order-wire pad	3RC20BF512J
R32	RESISTOR, fixed: comp; 820 ohms ±5%; ½ w; JAN No. RC20BF821J.	Reduces input voltage to bridge rectifier.	3RC20BF821J
R46	RESISTOR, fixed: comp; 10,000 ohms ±5%; ½ w; JAN No. RC20BF103J.	Used as part of order-wire pad	3RC20BF103J
R14, R17	RESISTOR, fixed: WW; inductive wdg; 10,500 ohms ±1%; ⅓ w; JAN No. RB16E10501F.	R14: Used as part of meter pad to measure plate supply voltage. R17: Used as part of meter pad to measure repeater voltage.	3RB6–1050.2
R40	RESISTOR, fixed: comp; 16,000 ohms ±5%; ½ w; JAN No. RC20BF163J.	Used as part of order-wire pad	3RC20BF163J
R13	RESISTOR, fixed: WW; inductive wdg; 17,200 ohms ±1%; ⅓ w; JAN No. RB16E17201F.	Extends meter range for measuring filament voltage.	3RB6–1720.1
R28	RESISTOR, fixed: comp; 27,000 ohms ±5%; ½ w; JAN No. RC20BF273J.	Regulates bridge rectifier output	3RC20BF273J
R6	RESISTOR, fixed: film; 27,100 ohms ±1%; ½ w; deposited carbon.	Used as amplifier input pad resistor	3Z6627A1–2
R1, R3	RESISTOR, fixed: film; 32,000 ohms ±1%; ½ w; deposited carbon.	Used as amplifier input pad resistors.	3Z6632–2
R12	RESISTOR, fixed: comp; 47,000 ohms ±5%; ½ w; JAN No. RC20BF473J.	Matches T1 secondary circuit impedance to V2 plate impedance.	3RC20BF473J
R15, R18, R20	RESISTOR, fixed: WW; inductive wdg; 80,600 ohms ±1%; ⅓ w; JAN No. RB16E80601F.	R15: Used as part of meter pad to measure plate supply voltage. R18, R20: Used as parts of meter pad to measure repeater voltage.	3RB6–8060.1
R7	RESISTOR, fixed: film; 100,000 ohms ±1%; ½ w; deposited carbon.	Forms voltage divider with resistor R8.	3Z6700–234
R9, R11	RESISTOR, fixed: comp; 200,000 ohms ±5%; ½ w; JAN No. RC20BF204J.	R9: Used as grid leak resistor for V1 control grid. R11: Used as grid leak resistor for V2 control grid.	3RC20BF204J
R21	RESISTOR, variable: WW; 1 sect, 6 ohms ±5%; 2 w; 3 term., solder lug type; JAN No. RA20A1RD6ROAJ.	Adjusts A-battery voltage	3RA912
R10	RESISTOR, variable: comp; 1 sect, 10,000 ohms, ±10%; 2 w; 3 term.	Adjusts amplifier gain	3Z7410–234
R22	RESISTOR, variable: comp; 1 sect, 15,000 ohms, 10%; 2 w; 3 term., solder lug type.	Adjusts B-battery voltage	3Z7415–41
R8	RESISTOR, variable: comp; 1 sect, 50,000 ohms ±10%; 2 w nom power rating; 3 term., solder lug type.	Adjusts gain of 1-kc signal (adjusted during manufacture).	3Z7450–205
	SHIELD, electron tube: copper, tin pl; cylindrical shape; 1¾″ lg x .930″ wd x .810″ d o/a; bayonet mtg.	Shields tube from external electromagnetic fields.	2Z8304.57
XV1, XV2	SOCKET, electron tube: 7 cont; miniature size; oval shape; 1⅞″ lg x 1⅜″ wd x 1″ d.	Mount electron tubes	2Z8677.94
	STRAP, carrying: test set carrying strap; cotton webbing, olive drab; 6′ 9″ lg x 1″ wd.	Facilitates carrying of equipment	6Z8448–44
S5	SWITCH, lever, pile-up: 2 lever pos, 2 pos locking; metal body; 12 term., solder lug type.	Used as order-wire talk or ring switch.	3Z9580–11.85

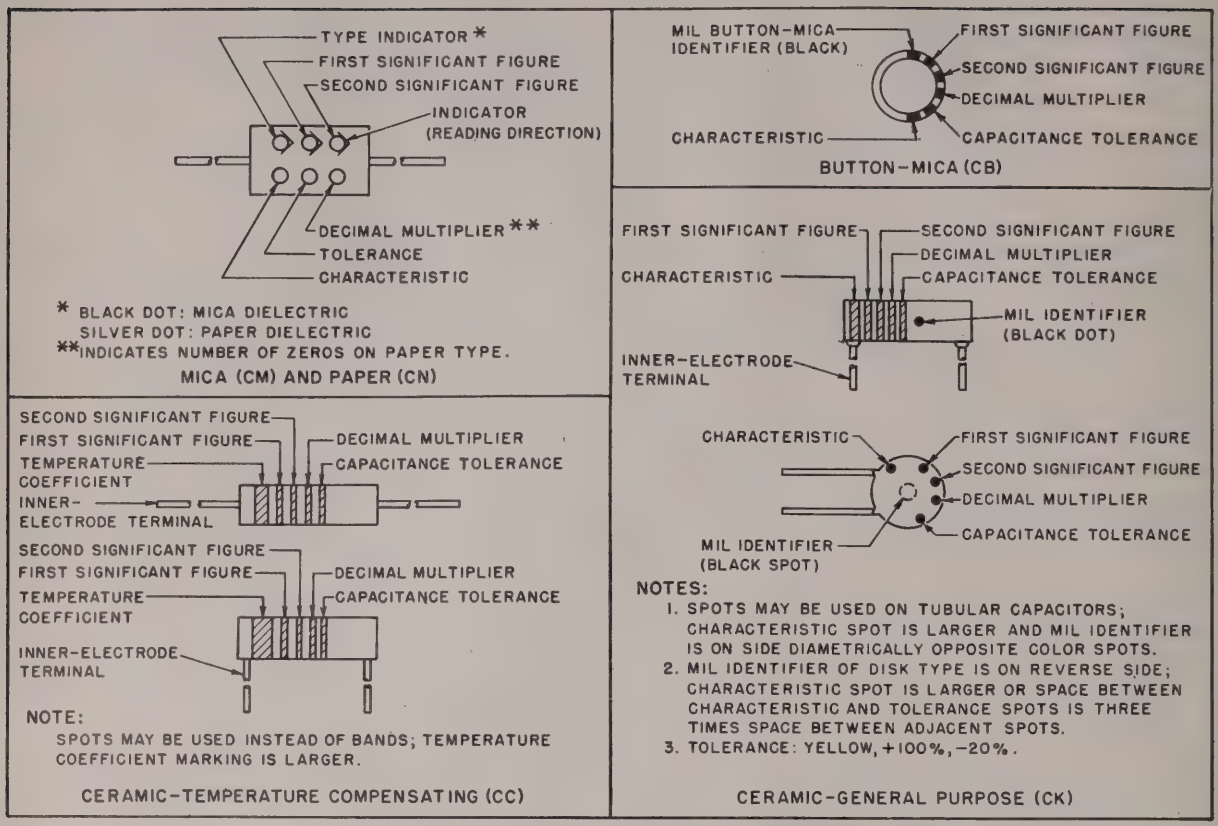
2. Main Chassis, Telephone Test Set TS–712/TCC–11 (Sig C stock No. 3F4325–712Z)—Con.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
S7	SWITCH, lever, pile-up: 2 lever pos; 1 pos locking, 1 pos momentary; 2″ lg x 1 5/32″ wd x 1 3/32″ h max; 4 term., 1 not used, solder lug type.	Connects pad into circuit to lower voltage in repeater for tube activity test.	3Z9580–11.86
S2	SWITCH, lever, pile-up: 2 lever pos; 1 pos locking, 1 pos momentary; 2″ lg x 1 5/32″ wd x 1 3/32″ h; 7 term., solder lug type.	Connects resistor into circuit to lower sensitivity at 1 kc.	3Z9580–11.87
S4	SWITCH, lever, pile-up: 2 lever pos, 2 pos locking; 1 7/8″ lg max x 1 9/10″ wd max x 1 3/32″ h max o/a; 16 term., solder lug type.	Removes meter shunt and connects batteries into circuit.	3Z9580–11.88
S6	SWITCH, rotary: 3 sect, 3 pos max; nonpile-up type; 1 15/16″ lg x 1 13/32″ wd x 1 17/32″ h; solder lug term.	Used as OW GAIN switch	3Z9825–36.18
S1	SWITCH, rotary: 4 sect; 8 pos nonpile-up type; 3 5/16″ lg x 1 13/32″ wd x 1 17/32″ h; solder lug term.	Selects proper signal in the AN/TCC–11 repeater for transmission tests.	3Z9825–36.19
S3	SWITCH, rotary: 4 sect; 8 pos max number of switching pos possible; nonpile-up type; 2 1/8″ lg x 1 13/32″ wd x 1 17/32″ h; solder lug term.	Selects the input voltage to meter M1.	3Z9825–36.20
	TERMINAL BOARD: 4 term., solder lug type; marked C1 and C2.	Provides electrical terminations	3Z770–4.182
	TERMINAL BOARD: 4 term., solder lug type; marked C5 and C6.	Provides electrical terminations	3Z770–4.183
	TERMINAL BOARD: 25 term., solder lug type; 5 19/32″ lg x 1 1/4″ wd x 1/8″ thk w/o term. o/a.	Provides electrical terminations	3Z770–25.14
	TERMINAL BOARD: 4 term.; 1″ lg x 3/4″ wd x 3/16″ thk o/a.	Provides plug- and jack-type electrical connection.	3Z770–4.148
E3 through E10	TERMINAL, STUD: solder connections; 5/8″ lg x 1/4″ wd o/a excluding mtg stud.	Provides electrical connection	3Z12101–9.9
T3	TRANSFORMER, AF: line type; pri 600 ohms, secd 800 +800 ohms, pri tapped; +2 dbm max audio oper level; 2.54 to 1 and 1.63 to 1 ratio of turns pri to secd; ±.5 db from 300 to 2,800 cy freq response, not tuned.	Used as order-wire hybrid transformer.	2Z9637.158
T1	TRANSFORMER, AF: plate coupling type; pri 30,000 ohms (3–4), secd 20,000 ohms (1–2); 1 dbm max audio oper level; 1.224 turns ratio pri (3–4) to secd (1–2).	Couples V2 amplifier output to V2 diode.	2Z9632.780
T2	TRANSFORMER, AF: plate coupling type; pri (3–4) rated 7.0 ma, secd (1–2) rated 3.0 ma; +14 dbm max audio oper level; 29.4:4.2:1 approx ratio of turns between (3–5) : (3–4) : (1–2).	Couples collector output to emitter circuit.	2Z9632.781
CR5	VARISTOR: silicon carbide type; 2667 ohms min, 3333 ohms max at 15 ma dc; 3/4″ varistor disk, 1 mtg bolt.	Used as voltage limiter	3H4860–281

3. Subassembly, Electrical Dummy Load Z1 (Sig C stock No. 2Z3904–17)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
(Z1) W1	CABLE ASSEMBLY, telephone: 4 cond; polyethylene ins; 22½″ max lg excluding term. leads; WF–8/G cable.	Connects electrical dummy load artificial cable Z1 to equipment under test.	3E4004.11
(Z1) Z1	LOAD, dummy electrical: solder lug type; on mtg surface; c/o 6 cap., 6 res, 6 coils; 2 9/16″ lg x 1 7/16″ wd x 3 5/32″ h.	Used as cable-simulating network	2Z3904–15
(Z1) R1	RESISTOR, fixed: film; 2 meg ±1%; 1 w.	Used as part of artificial cable	3Z6802–59
(Z1) T1, (Z1) T2	TRANSFORMER, carrier: line type; pri 135 ohms (1–2) (3–4), secd 1800 ohms (5–6) (7–8), ct 67.5 ohms.	Used as line matching transformers	2Z9637–190

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

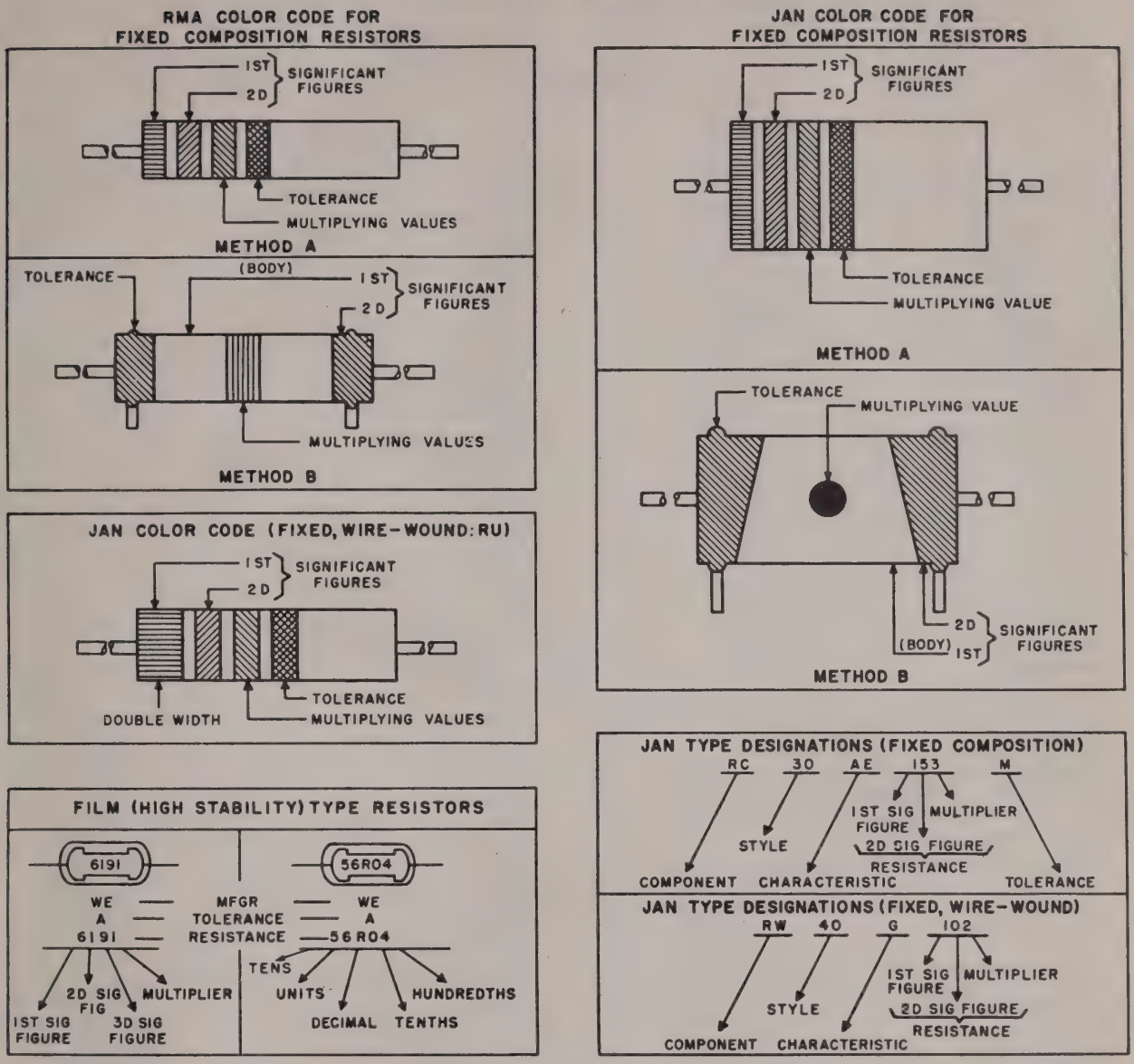
COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 39. Capacitor color codes.

RESISTOR COLOR AND LETTER CODE



STANDARDS					
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE(%)	JAN LETTER TOLERANCE	WE LETTER TOLERANCE
BLACK	0	1	—	—	—
BROWN	1	10	±1	F	A
RED	2	100	±2	G	B
ORANGE	3	1,000	±3	—	—
YELLOW	4	10,000	±4	—	—
GREEN	5	100,000	±5	—	C
BLUE	6	1,000,000	±6	—	—
VIOLET	7	10,000,000	±7	—	—
GRAY	8	100,000,000	±8	—	—
WHITE	9	1,000,000,000	±9	—	—
GOLD	—	0.1	±5	J	—
SILVER	—	0.01	±10	K	—
NO COLOR	—	—	±20	M	—

NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION
3. JAN: JOINT ARMY-NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS

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Figure 40. Resistor color and letter codes.

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[AG 413.42 (3 Nov 53)]

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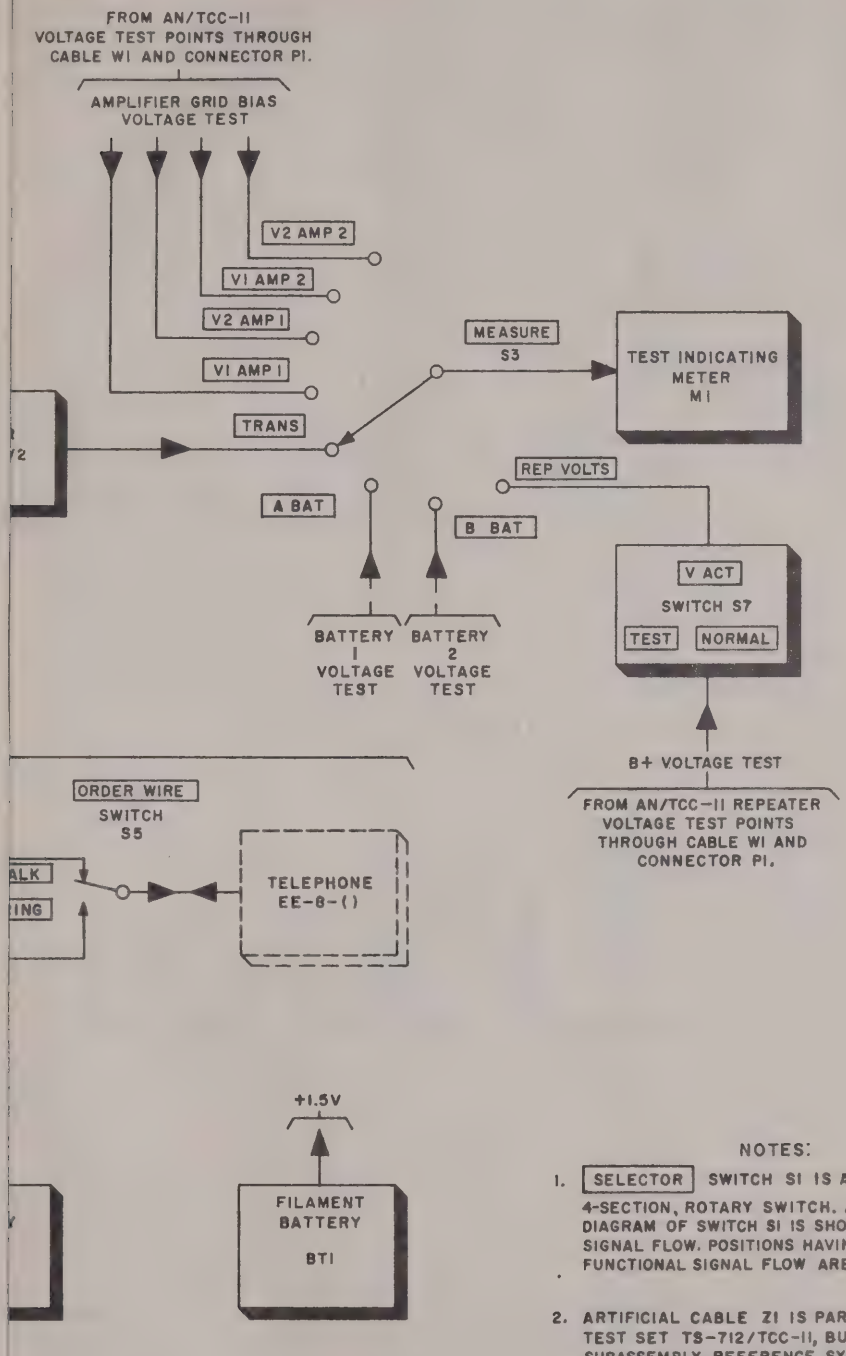

NOTES:

1. SELECTOR SWITCH S1 IS AN 8-POSITION, 4-SECTION, ROTARY SWITCH. A FUNCTIONAL DIAGRAM OF SWITCH S1 IS SHOWN TO ILLUSTRATE SIGNAL FLOW. POSITIONS HAVING THE SAME FUNCTIONAL SIGNAL FLOW ARE GROUPED.

2. ARTIFICIAL CABLE Z1 IS PART OF TELEPHONE TEST SET TS-712/TCC-11, BUT IS A SEPARATE SUBASSEMBLY. REFERENCE SYMBOLS PREFIXED BY (Z1) DESIGNATE PARTS USED IN ARTIFICIAL CABLE.

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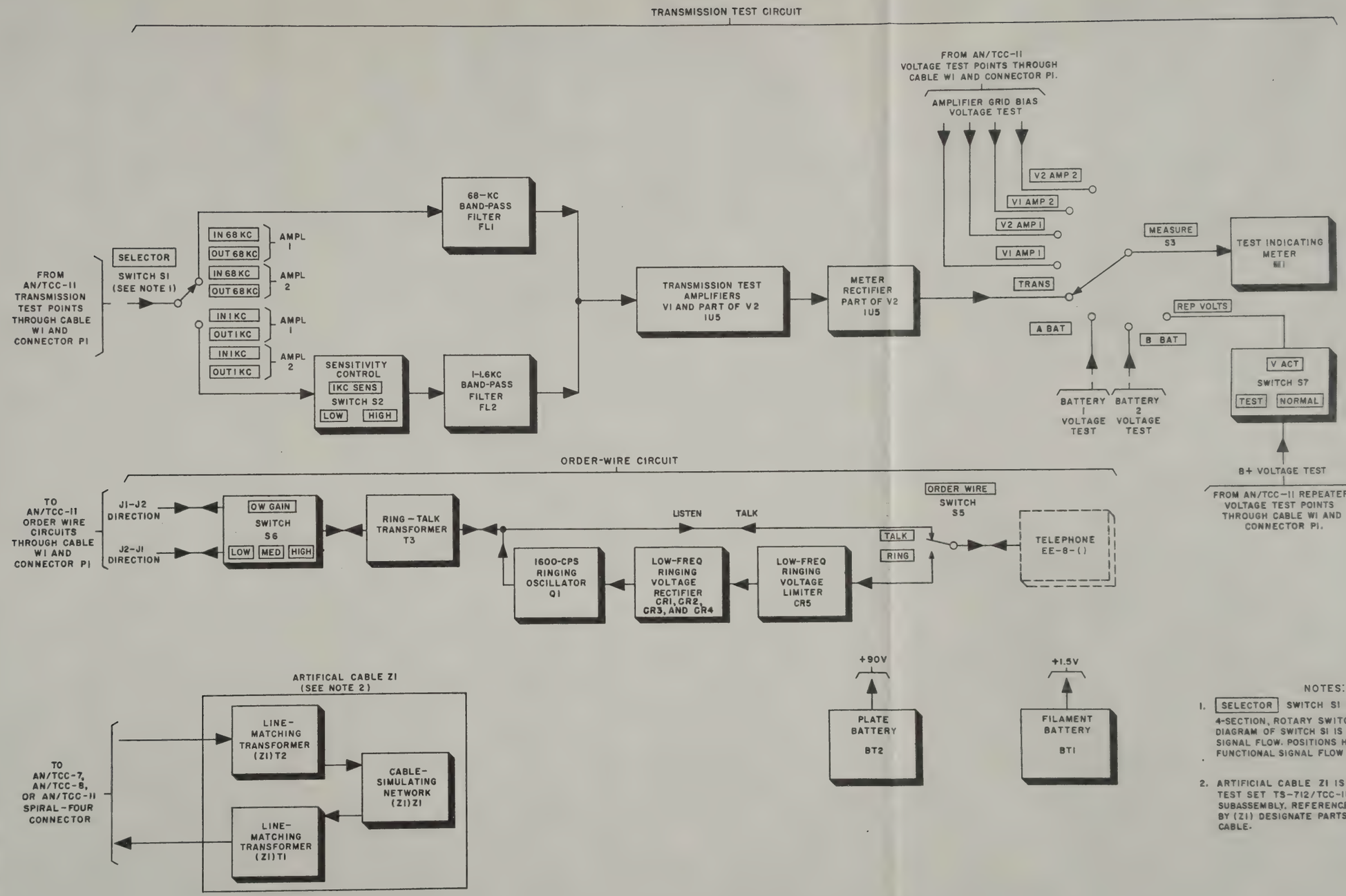

Figure 13.—Telephone Test Set TS-712/TCC-11, block diagram.

NOTES:

1. SELECTOR SWITCH S1 IS AN 8-POSITION, 4-SECTION, ROTARY SWITCH. A FUNCTIONAL DIAGRAM OF SWITCH S1 IS SHOWN TO ILLUSTRATE SIGNAL FLOW. POSITIONS HAVING THE SAME FUNCTIONAL SIGNAL FLOW ARE GROUPED.

2. ARTIFICIAL CABLE Z1 IS PART OF TELEPHONE TEST SET TS-712/TCC-11, BUT IS A SEPARATE SUBASSEMBLY. REFERENCE SYMBOLS PREFIXED BY (Z1) DESIGNATE PARTS USED IN ARTIFICIAL CABLE.

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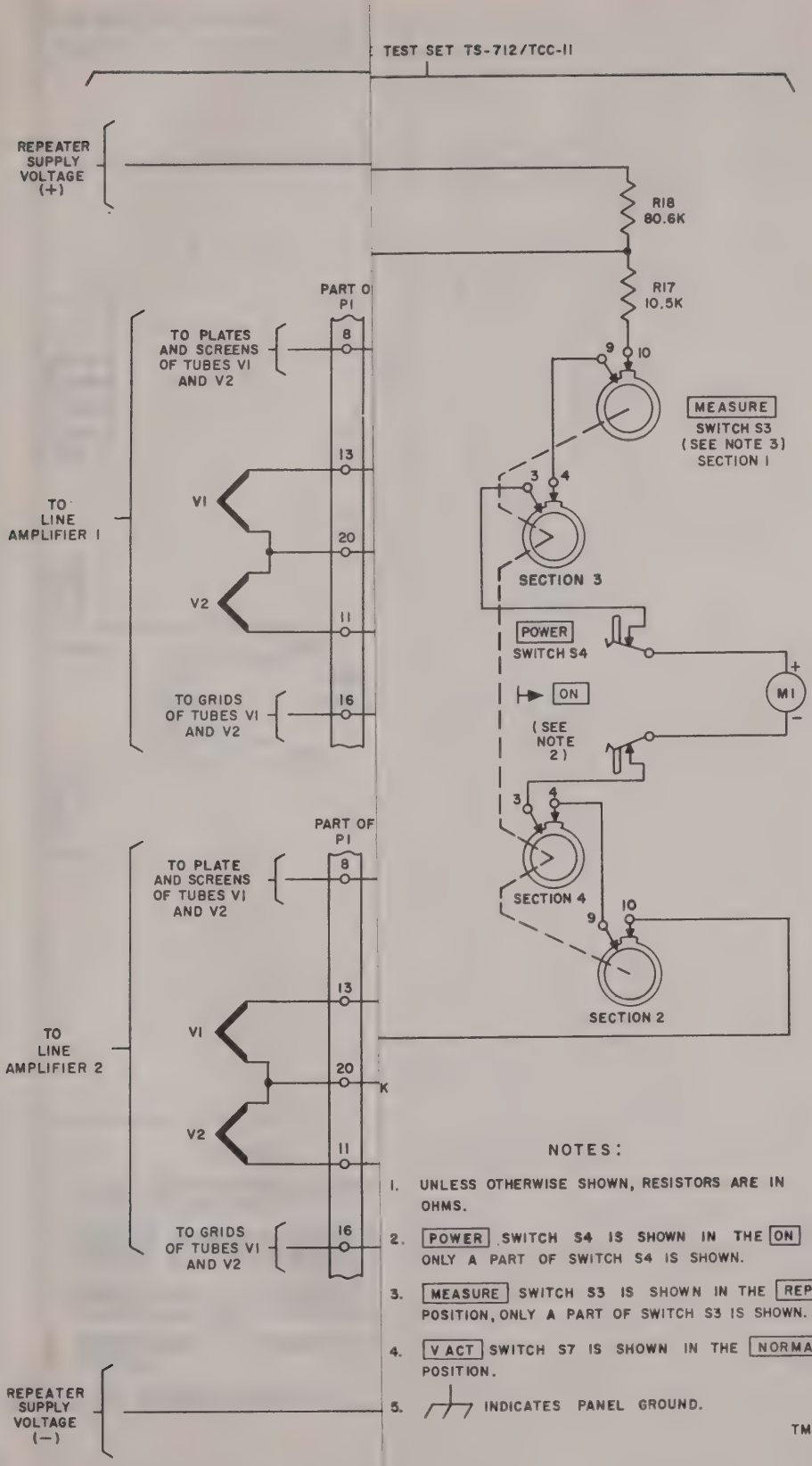
6084-4355A Face 108 no. 1

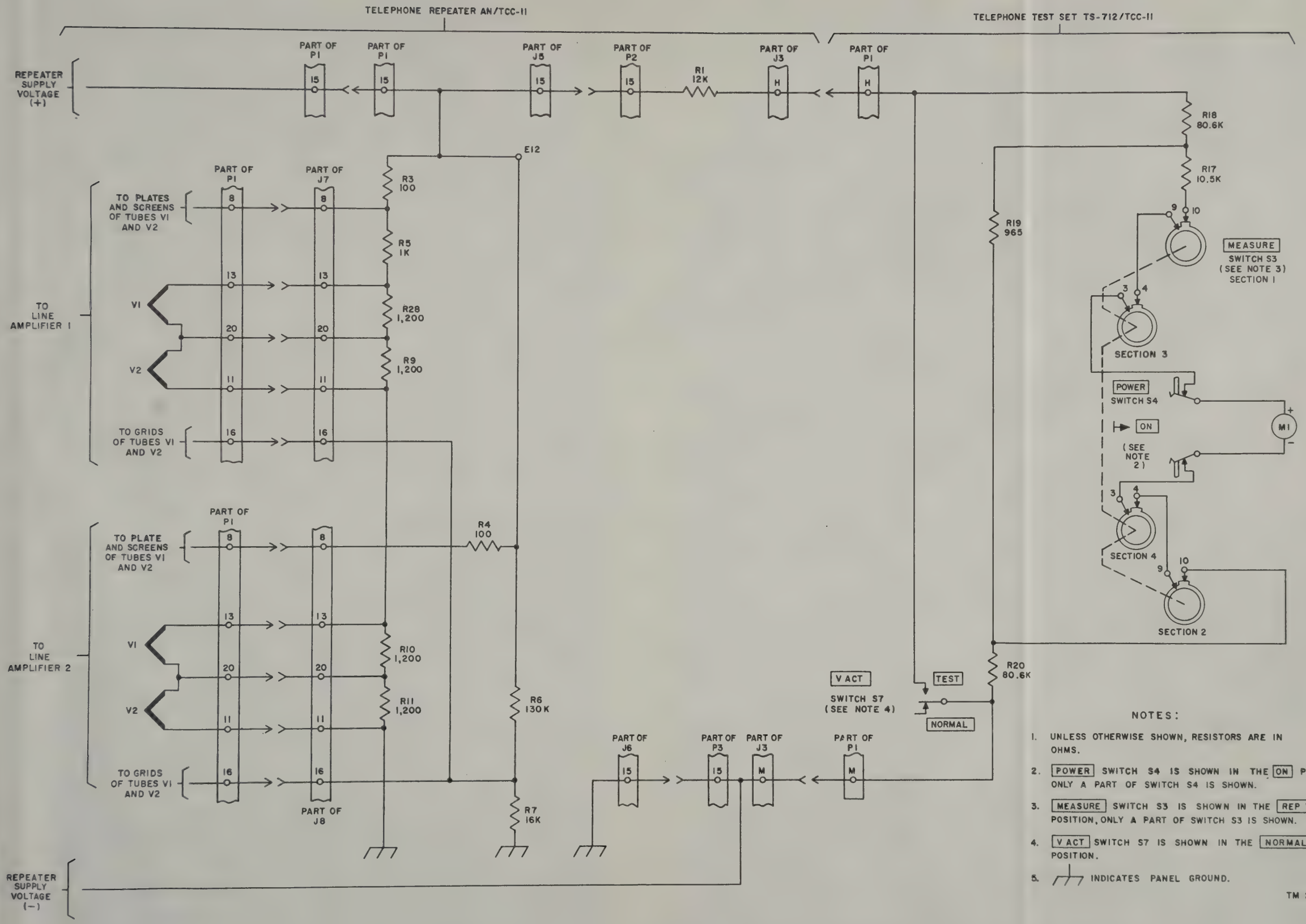


NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS.
2. POWER SWITCH S4 IS SHOWN IN THE ON POSITION, ONLY A PART OF SWITCH S4 IS SHOWN.
3. MEASURE SWITCH S3 IS SHOWN IN THE REP VOLTS POSITION, ONLY A PART OF SWITCH S3 IS SHOWN.
4. V ACT SWITCH S7 IS SHOWN IN THE NORMAL POSITION.
5. ⏚ INDICATES PANEL GROUND.

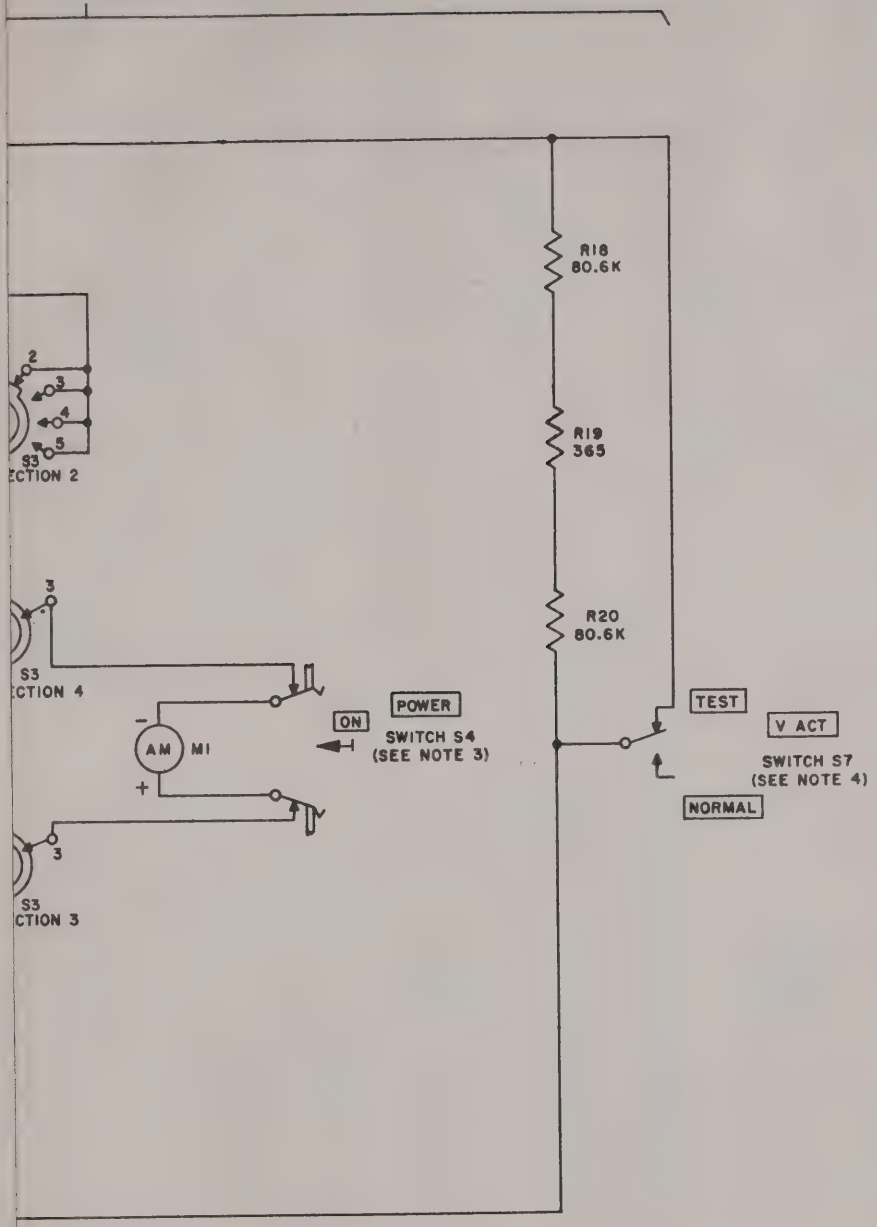
TM 2143-12

6034-435A Face 108 no. 2



6034-4355A Face 108 no. 2

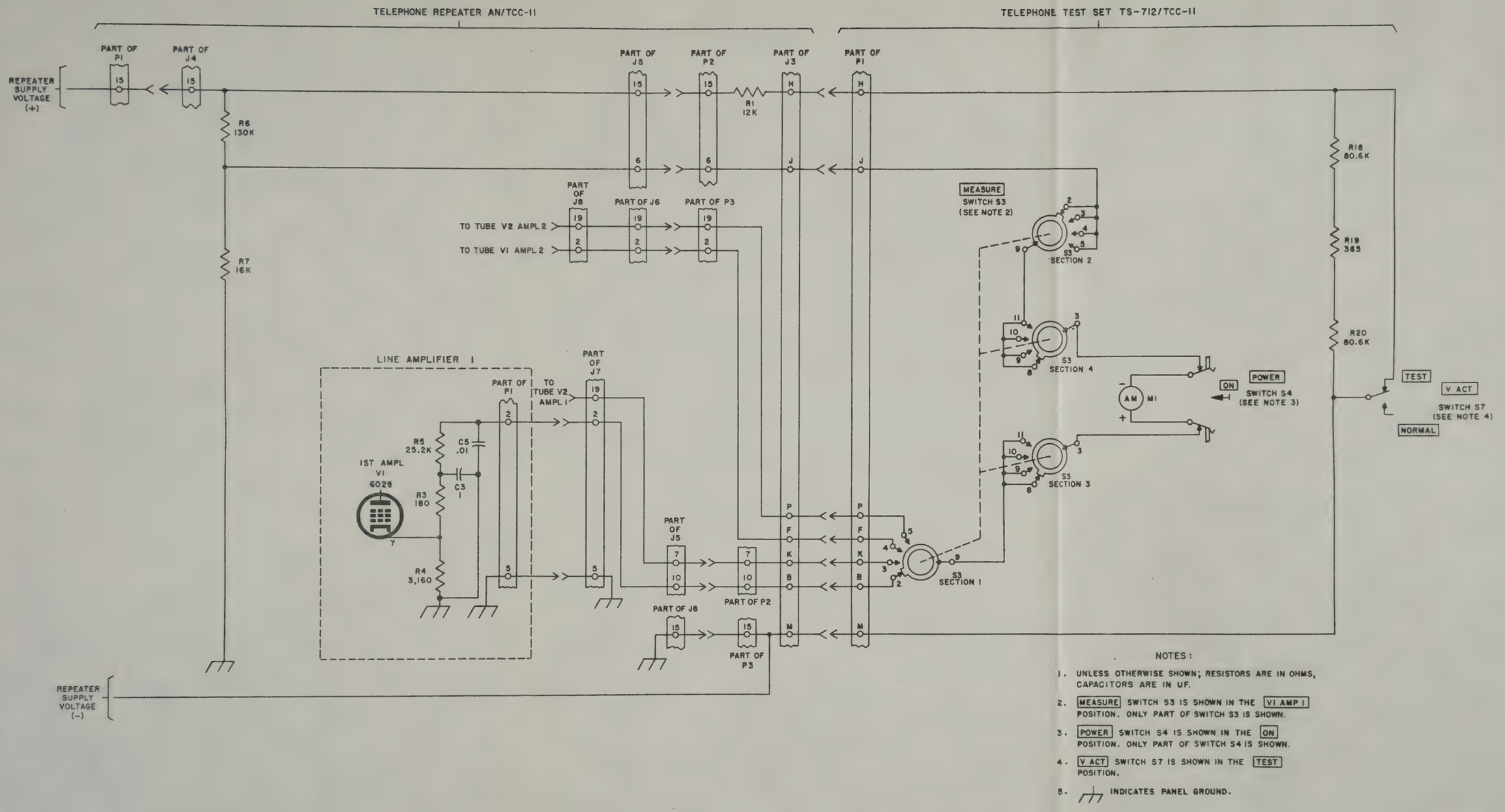
Figure 16.—TS-712 test set and AN/TCC-11 repeater d-c voltage transmission test circuit, simplified schematic diagram.



NOTES:

1. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. MEASURE SWITCH S3 IS SHOWN IN THE VI AMP I POSITION. ONLY PART OF SWITCH S3 IS SHOWN.
3. POWER SWITCH S4 IS SHOWN IN THE ON POSITION. ONLY PART OF SWITCH S4 IS SHOWN.
4. V ACT SWITCH S7 IS SHOWN IN THE TEST POSITION.
5. ⏚ INDICATES PANEL GROUND.

TM 2143-13

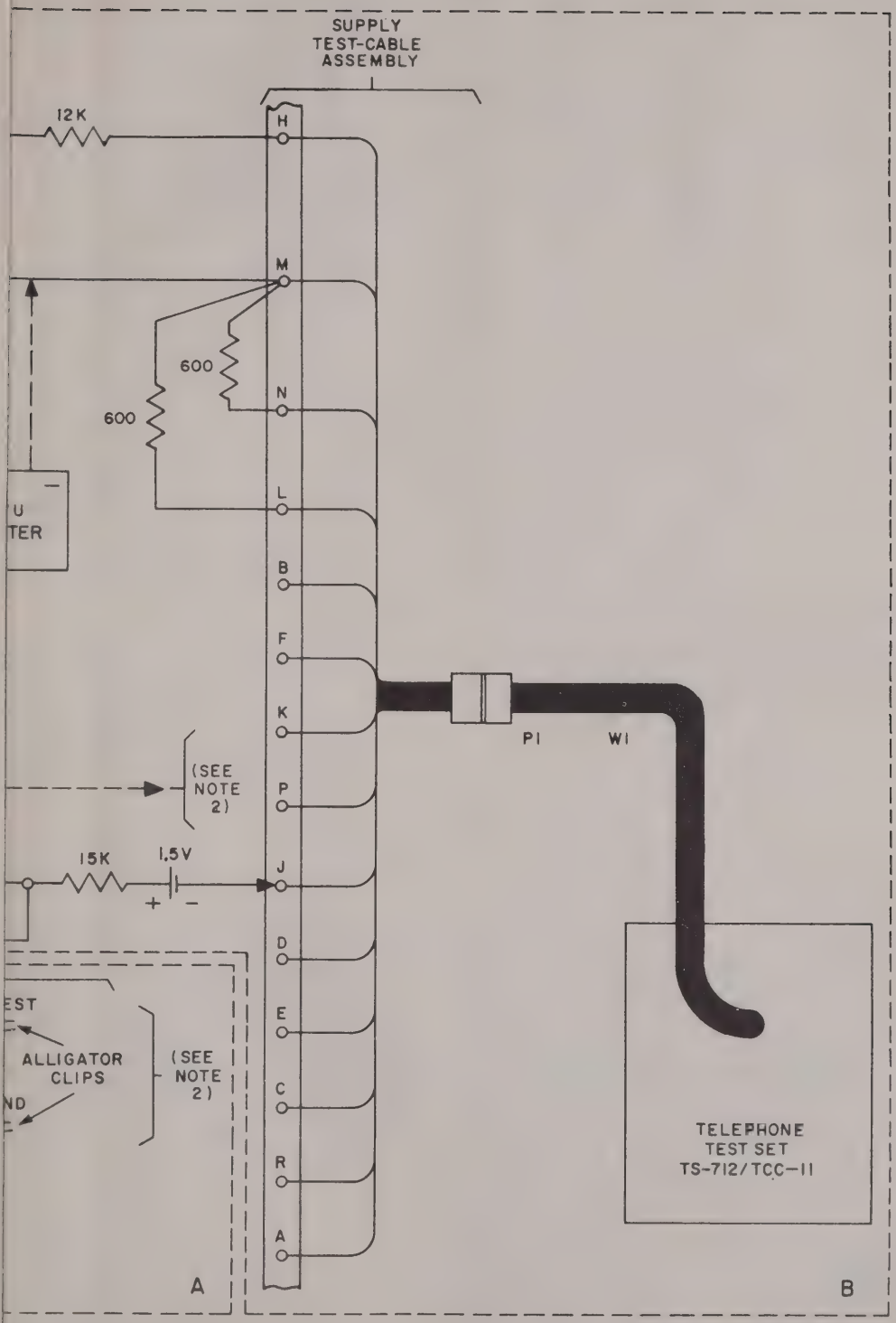


NOTES:

1. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. MEASURE SWITCH S3 IS SHOWN IN THE V1 AMP 1 POSITION. ONLY PART OF SWITCH S3 IS SHOWN.
3. POWER SWITCH S4 IS SHOWN IN THE ON POSITION. ONLY PART OF SWITCH S4 IS SHOWN.
4. V ACT SWITCH S7 IS SHOWN IN THE TEST POSITION.
5. ⏚ INDICATES PANEL GROUND.

TM 2143-13

Figure 17.—Telephone Repeater AN/TCC-11, vacuum-tube activity test, simplified schematic diagram


SUPPLY
TEST-CABLE
ASSEMBLY
12K
H
M
600
600
N
L
B
F
K
P
J
D
E
C
R
A
P1
W1
(SEE
NOTE
2)
15K
1.5V
+
-
ALLIGATOR
CLIPS
(SEE
NOTE
2)
TELEPHONE
TEST SET
TS-712/TCC-11
A
B

TM 2143-27

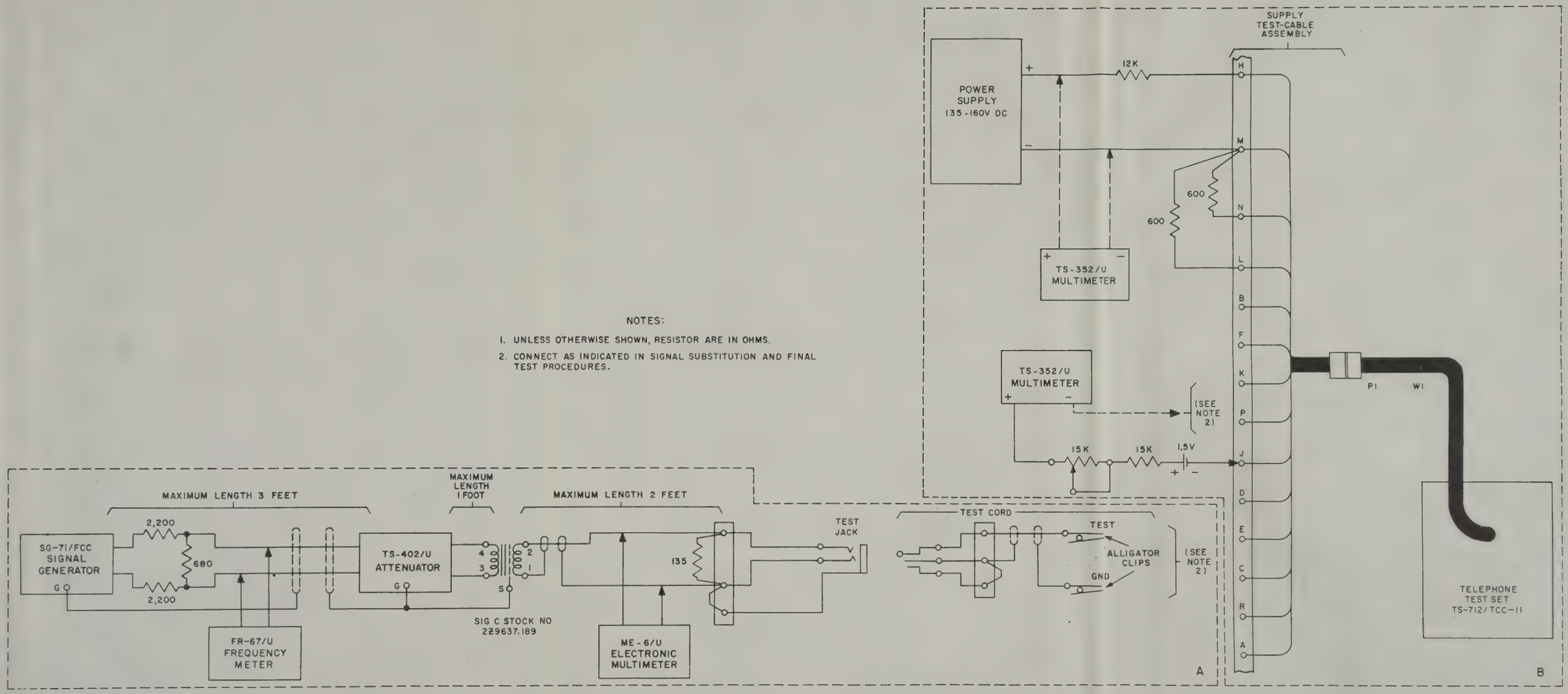
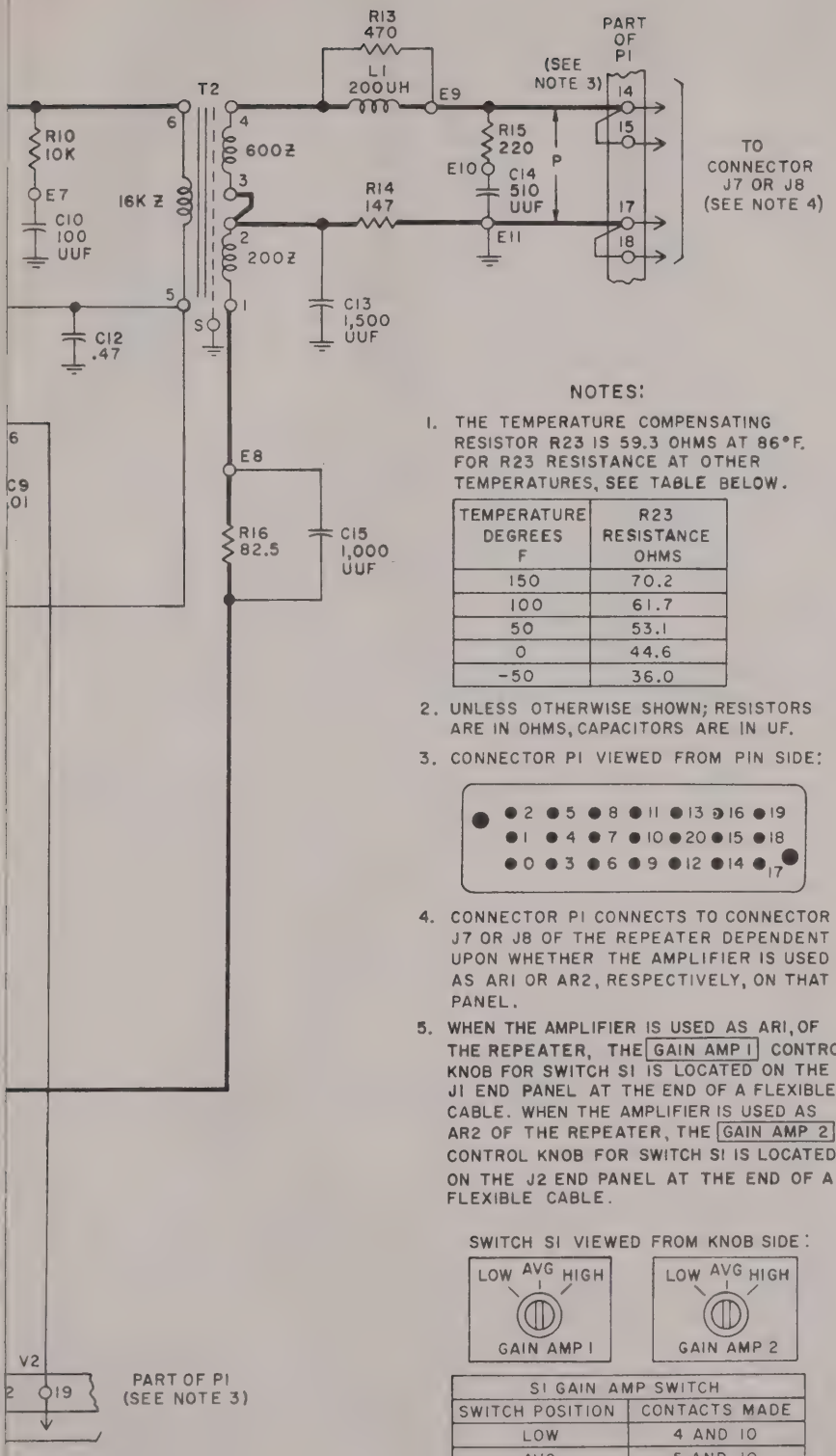


Figure 26.—Telephone Test Set TS-712/TCC-11, power test set-up and detector circuit test set-up.

TM 2143-27



NOTES:

1. THE TEMPERATURE COMPENSATING RESISTOR R23 IS 59.3 OHMS AT 86°F. FOR R23 RESISTANCE AT OTHER TEMPERATURES, SEE TABLE BELOW.

TEMPERATURE DEGREES F	R23 RESISTANCE OHMS
150	70.2
100	61.7
50	53.1
0	44.6
-50	36.0

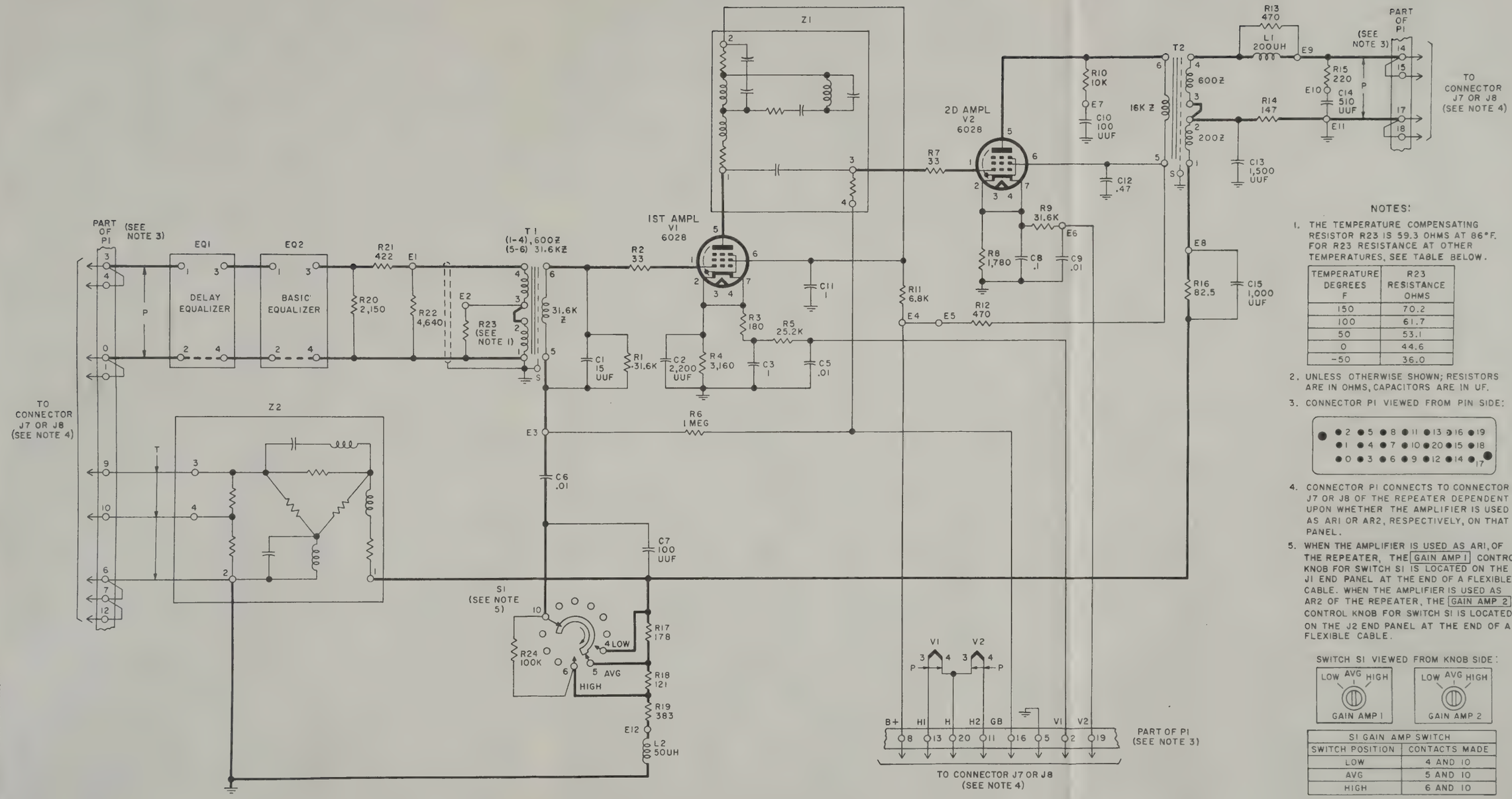
2. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
3. CONNECTOR P1 VIEWED FROM PIN SIDE:

4. CONNECTOR P1 CONNECTS TO CONNECTOR J7 OR J8 OF THE REPEATER DEPENDENT UPON WHETHER THE AMPLIFIER IS USED AS AR1 OR AR2, RESPECTIVELY, ON THAT PANEL.
5. WHEN THE AMPLIFIER IS USED AS AR1, OF THE REPEATER, THE GAIN AMP 1 CONTROL KNOB FOR SWITCH S1 IS LOCATED ON THE J1 END PANEL AT THE END OF A FLEXIBLE CABLE. WHEN THE AMPLIFIER IS USED AS AR2 OF THE REPEATER, THE GAIN AMP 2 CONTROL KNOB FOR SWITCH S1 IS LOCATED ON THE J2 END PANEL AT THE END OF A FLEXIBLE CABLE.

SWITCH S1 VIEWED FROM KNOB SIDE:

S1 GAIN AMP SWITCH	
SWITCH POSITION	CONTACTS MADE
LOW	4 AND 10
AVG	5 AND 10
HIGH	6 AND 10

TM 2143-20



NOTES:

1. THE TEMPERATURE COMPENSATING RESISTOR R23 IS 59.3 OHMS AT 86°F. FOR R23 RESISTANCE AT OTHER TEMPERATURES, SEE TABLE BELOW.

TEMPERATURE DEGREES F	R23 RESISTANCE OHMS
150	70.2
100	61.7
50	53.1
0	44.6
-50	36.0

2. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
3. CONNECTOR P1 VIEWED FROM PIN SIDE:

4. CONNECTOR P1 CONNECTS TO CONNECTOR J7 OR J8 OF THE REPEATER DEPENDENT UPON WHETHER THE AMPLIFIER IS USED AS AR1 OR AR2, RESPECTIVELY, ON THAT PANEL.
5. WHEN THE AMPLIFIER IS USED AS AR1, OF THE REPEATER, THE GAIN AMP 1 CONTROL KNOB FOR SWITCH S1 IS LOCATED ON THE J1 END PANEL AT THE END OF A FLEXIBLE CABLE. WHEN THE AMPLIFIER IS USED AS AR2 OF THE REPEATER, THE GAIN AMP 2 CONTROL KNOB FOR SWITCH S1 IS LOCATED ON THE J2 END PANEL AT THE END OF A FLEXIBLE CABLE.

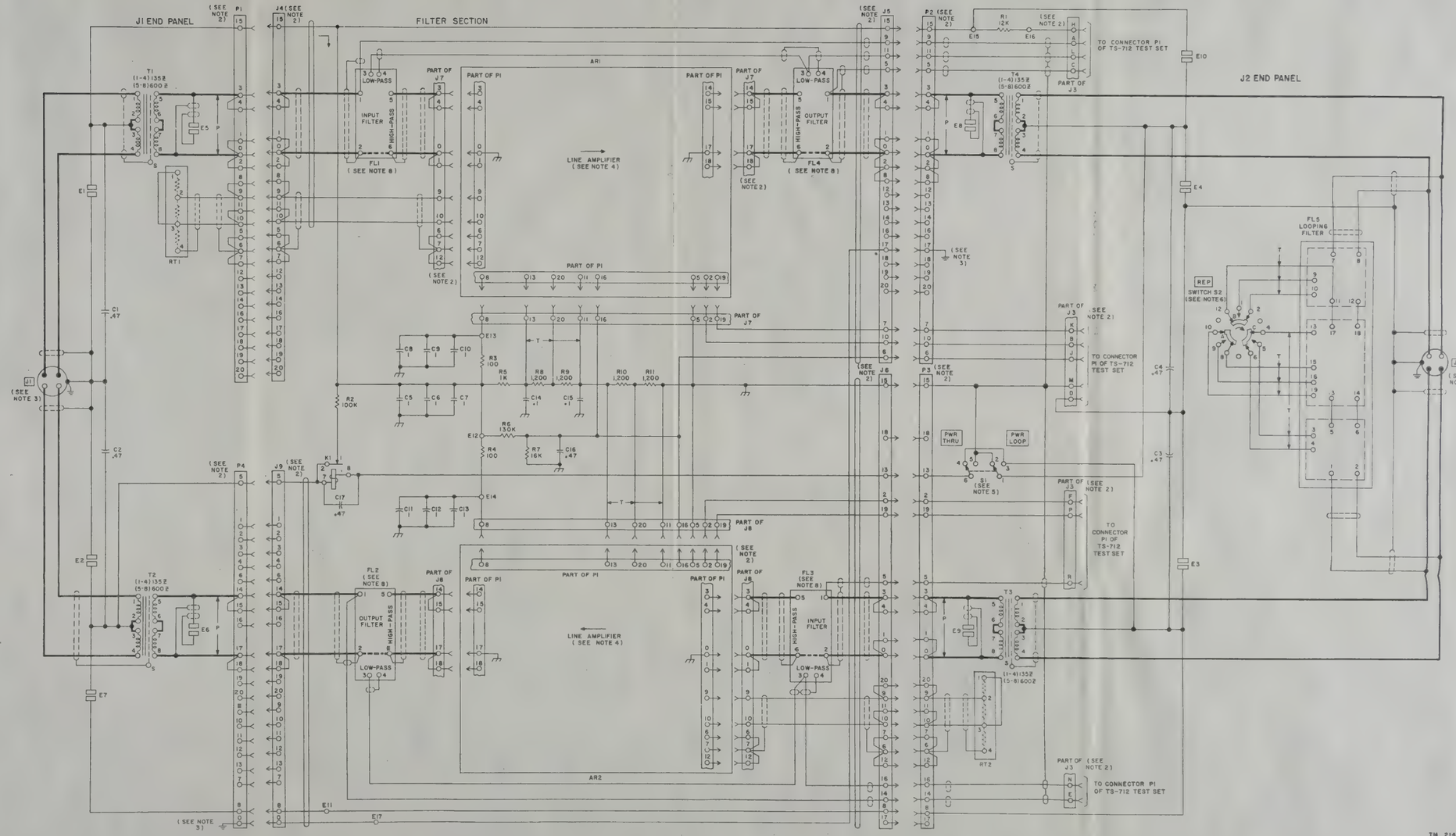
SWITCH S1 VIEWED FROM KNOB SIDE:

S1 GAIN AMP SWITCH	
SWITCH POSITION	CONTACTS MADE
LOW	4 AND 10
AVG	5 AND 10
HIGH	6 AND 10

TM 2143-20

6034-435A Face 103 no. 5

Figure 41.—Telephone Repeater AN/TCC-11, line amplifier, schematic diagram.



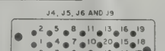
NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. CONNECTORS P1 THROUGH P4, J3 THROUGH J9 VIEWED FROM PIN SIDE.

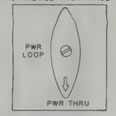
P1, P2, P3, P4, J7 AND J8

J3

J4, J5, J6 AND J9



3. CABLE CONNECTORS J1 AND J2, PIN O OF CONNECTOR P4, PIN D OF J3, AND PIN 17 OF CONNECTOR P2 ARE CONNECTED TO CYLINDRICAL CASE GROUND. ALL GROUNDS INDICATED ⏚ ARE PANEL GROUNDS AND ARE INSULATED FROM CYLINDRICAL CASE.
4. FOR CIRCUIT DETAILS OF LINE AMPLIFIERS AR1 AND AR2 SEE LINE AMPLIFIER SCHEMATIC DIAGRAM.
5. SWITCH S1 VIEWED FROM KNOB SIDE:



6. SWITCH S2 VIEWED FROM KNOB SIDE:

S2 REP SWITCH
TABLE OF CONTACTS MADE

SWITCH POSITION	SELECTIVE FREQ. KC	SECTION A	B	C
1	99	—	—	—
2	91	8—9	12—1	4—5
3	83	6—10	12—2	4—6

7. T DENOTES TRIPLE (THREE WIRES TWISTED TOGETHER).
8. TERMINALS 2, 4, AND 6 ARE CONNECTED TOGETHER WITHIN THE FILTER.

6614-455A Page 108 no. 6

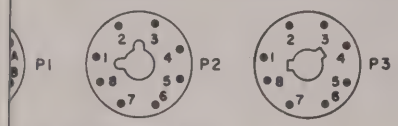
Figure 42.—Telephone Repeater AN/TCC-11, block-schematic diagram.

TM 2143-21

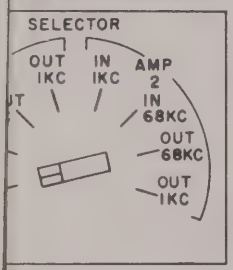
NOTES:

RWISE SHOWN; RESISTORS ARE IN OHMS,
ARE IN UF.

PI, P2 AND P3 ARE VIEWED FROM PIN SIDE.

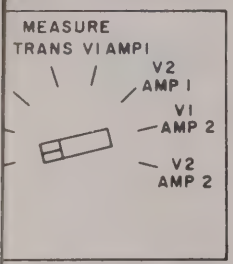


WED FROM KNOB SIDE.



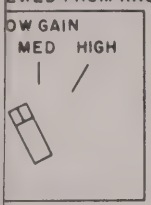
S1 SELECTOR SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
IN IKC AMP 1	1-12	12-1	1-11	10-11
IN 68KC AMP1	2-12	12-2	2-11	10-11
OUT 68KC AMP1	3-12	12-3	3-11	4-11
OUT IKC AMP 1	4-12	12-4	4-11	—
IN IKC AMP 2	5-12	12-5	—	6-4
IN 68KC AMP 2	6-12	12-6	—	7-4
OUT 68KC AMP2	7-12	12-7	7-5	8-4
OUT IKC AMP 2	8-12	12-8	—	9-4

EWED FROM KNOB SIDE:



S3 MEASURE SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
REP VOLTS	10-9	9-10	4-3	3-4
B BAT	11-9	9-11	5-3	3-5
A BAT	12-9	9-12	6-3	3-6
TRANS	1-9	9-1	3-7	7-3
V1 AMP 1	2-9	9-2	8-3	3-8
V2 AMP 1	3-9	9-3	9-3	3-9
V1 AMP2	4-9	9-4	10-3	3-10
V2 AMP2	5-9	9-5	11-3	3-11

EWED FROM KNOB SIDE.

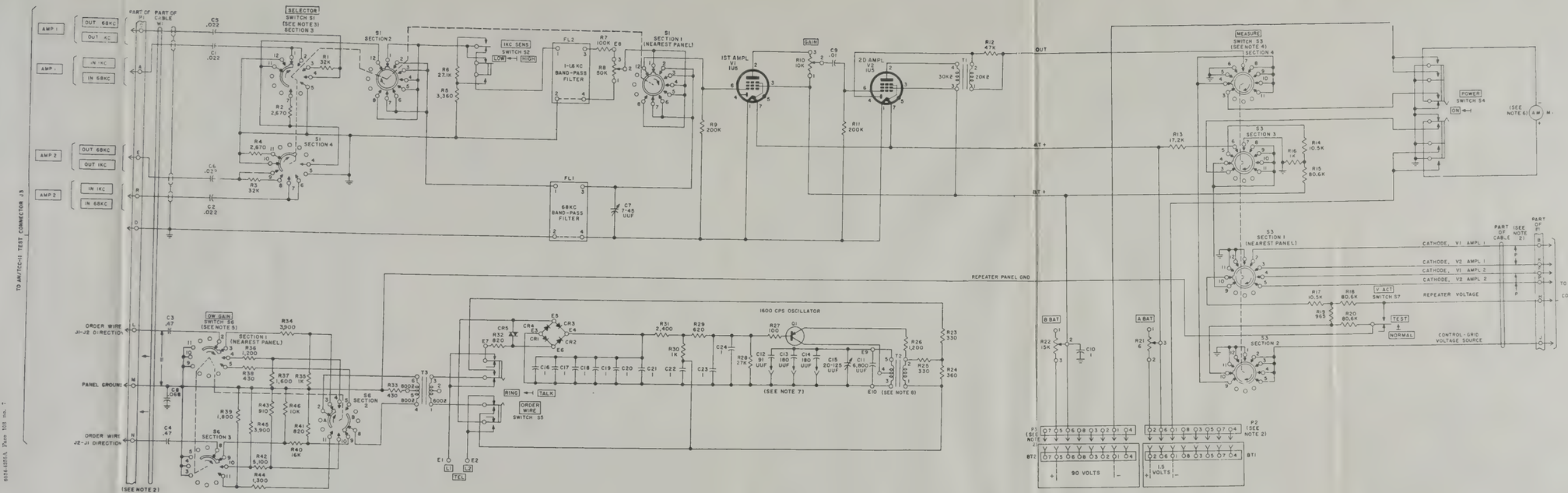


S6 OW GAIN SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2A	SECTION 2B	SECTION 3
LOW	2-3	3-2	8-9	9-8
MED	2-4	4-2	8-10	10-8
HIGH	2-5	5-2	8-11	11-8

A MICROAMMETER CALIBRATED IN DECIBELS.

QUIRED TO OBTAIN PROPER FREQUENCY UPON
NT OF ASSOCIATED PARTS.

ATIOS OF THE WINDINGS OF TRANSFORMER T2
LOWS: 29.4 (WINDING 3-5): 4.2 (WINDING 3-4): 1 (WINDING 1-2).



NOTES

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF
2. CONNECTORS P1, P2 AND P3 ARE VIEWED FROM PIN SIDE

3. SWITCH S1 VIEWED FROM KNOB SIDE

S1 SELECTOR SWITCH TABLE OF CONTACTS MADE

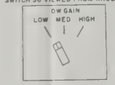
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
IN 1KC AMP 1	12	2	2-11	10-11
IN 68KC AMP 1	2-12	12-2	2-11	10-11
OUT 68KC AMP 1	3-2	12-3	3-11	4-11
OUT 1KC AMP 1	4-12	12-4	4-11	—
IN 1KC AMP 2	5-2	2-5	—	6-4
IN 68KC AMP 2	6-12	2-6	—	7-4
OUT 68KC AMP 2	7-12	2-7	7-5	8-4
OUT 1KC AMP 2	8-12	2-8	—	9-4

4. SWITCH S3 VIEWED FROM KNOB SIDE

S3 MEASURE SWITCH TABLE OF CONTACTS MADE

SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
REP VOLTS	10-9	9-10	4-3	3-4
B BAT	11-9	9-11	5-3	3-5
A BAT	12-9	9-12	6-3	3-6
TRANS	-9	9-	3-7	7-3
V1 AMP 1	2-9	9-2	8-3	3-8
V2 AMP 1	3-9	9-3	9-3	3-9
V1 AMP 2	4-9	9-4	10-3	3-10
V2 AMP 2	5-9	9-5	11-3	3-11

5. SWITCH S6 VIEWED FROM KNOB SIDE



S6 LOW GAIN SWITCH TABLE OF CONTACTS MADE

SWITCH POSITION	SECTION 1	SECTION 2A	SECTION 2B	SECTION 3
LOW	2-3	3-2	8-9	9-8
MED	2-4	4-2	8-10	10-8
HIGH	2-5	5-2	8-11	11-8

6. METER M1 IS A MICROAMMETER CALIBRATED IN DECIBELS
7. STRAP AS REQUIRED TO OBTAIN PROPER FREQUENCY UPON REPLACEMENT OF ASSOCIATED PARTS
8. THE TURNS RATIOS OF THE WINDINGS OF TRANSFORMER T2 ARE AS FOLLOWS: 29.4 (WINDING 3-5): 4.2 (WINDING 3-4): 1 (WINDING 1-2).

TM 2143-22

Figure 43.—Telephone Test Set TS-718/TCC-11, schematic diagram.

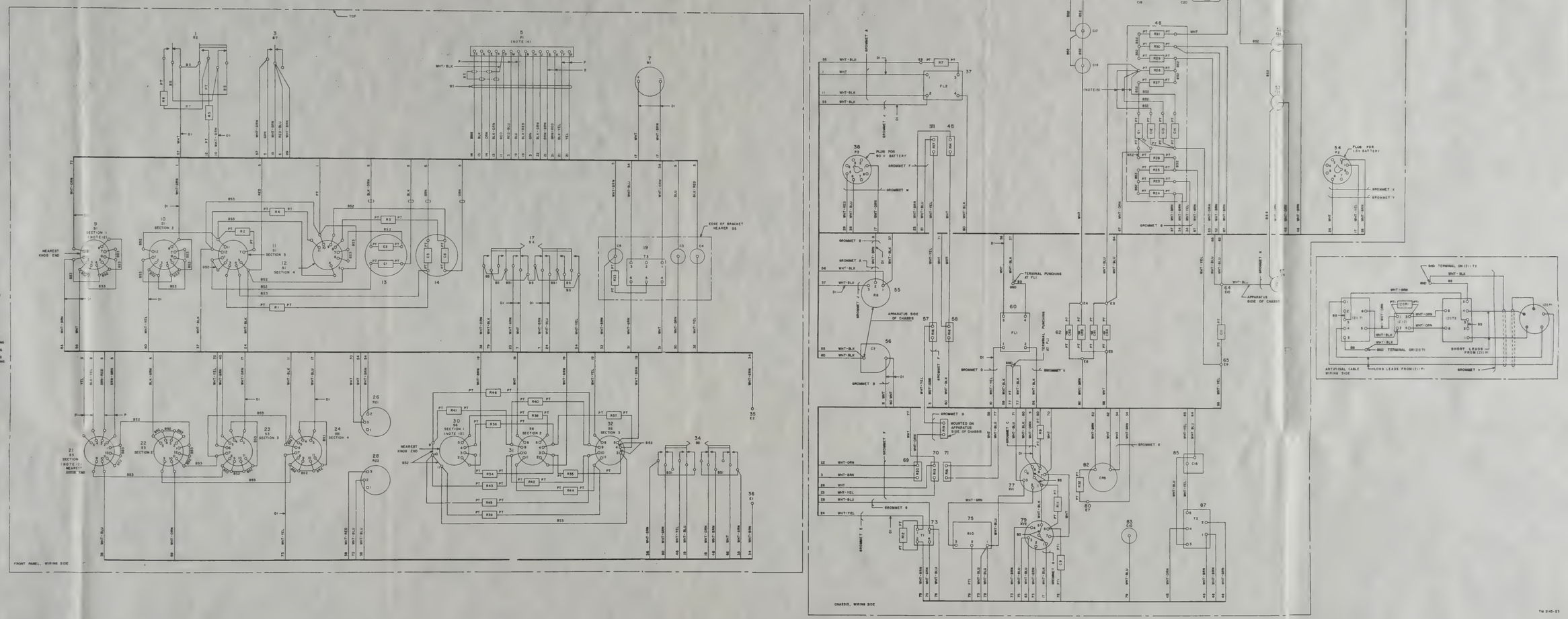
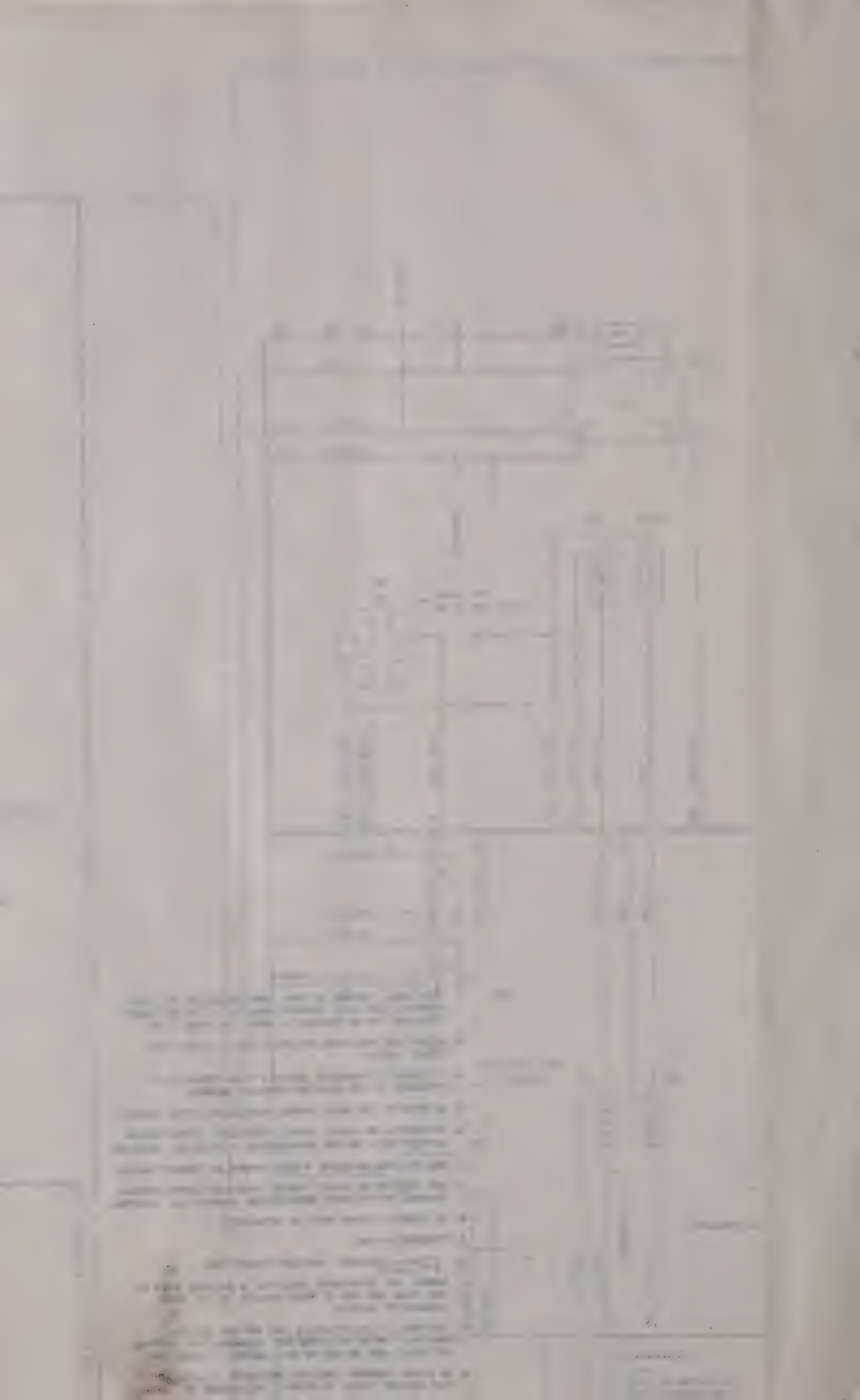

NOTES:
1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAGE WITH BYLOW JACKET.
3. DI WIRING IS CONNECTED DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER
4. BN DENOTES 22 GAGE TINNED, ANNEALED COPPER WIRING
5. WH DENOTES 22 GAGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBREGLAS SLEEVING
6. BSG DENOTES 20 GAGE TINNED, ANNEALED COPPER WIRING
7. BSD DENOTES 20 GAGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBREGLAS SLEEVING
8. PT DENOTES LEADS PART OF APPARATUS.
9. P DENOTES PAIR.
10. DENOTES SHIELDED CONNECTION
11. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER
12. TERMINALS INSIDE OF CIRCLE ARE ON SIDE OF DISK FARTHEST FROM KNOB END AND TERMINALS ON OUTSIDE OF CIRCLE ARE ON SIDE OF DISK NEAREST TO KNOB END.
13. DI WIRING RUNNING THROUGH GROMMETS A,B,C,D, AND E HAS ENOUGH SLACK TO PERMIT THE CHASSIS TO HINGE
14. CONNECTOR P1 IS A CIRCULAR CONNECTOR PHYSICAL PIN LOCATION IS SHOWN ON SCHEMATIC DIAGRAM OF THE TELEPHONE TEST SET TS-713/TCC-11 CIRCUIT
15. CAPACITORS C15, C20, AND C16 ARE STRAPPED SO THAT THE 1600 CYCLE TRANSFORMER T2 MAY BE PROPERLY TUNED.
TOP
FRONT PANEL, WIRING SIDE
CHASSIS, WIRING SIDE
ARTIFICIAL CABLE WIRING SIDE
APPARATUS SIDE OF CHASSIS
MOUNTED ON APPARATUS SIDE OF CHASSIS
NEAREST KNOB END
EDGE OF BRACKET NEAREST S5
TERMINAL PUNCHING #2 FL1
TERMINAL PUNCHING #1 FL1
PLUG FOR 90 V BATTERY
PLUG FOR 1.5V BATTERY
END TERMINAL ON (2) T2
END TERMINAL ON (2) T1
LONG LEADS FROM (2) P1
SHORT LEADS FROM (2) P1
GROMMET A
GROMMET B
GROMMET C
GROMMET D
GROMMET E
GROMMET F
GROMMET G
GROMMET H
GROMMET J
GROMMET K
GROMMET L
GROMMET M
GROMMET N
GROMMET P
GROMMET R
GROMMET S
GROMMET T
GROMMET U
GROMMET V
GROMMET W
GROMMET X
GROMMET Y

Figure 44.—Telephone Test Set TS-713/TCC-11 and artificial cable Z1, wiring diagram.

TM 0143-83



TELEPHONE TEST SET TS–712/TCC–11

TM 11–2143
CHANGES No. 4

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., *2 August 1962*

TM 11–2143, 23 November 1953, is changed as indicated so that the manual also applies to Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62.

Note. References to a previous Changes (example: changed by C 3, 21 February 1962) indicates that pertinent material was published in that Changes.

Page 7, chapter 1. Add the following "Note" below the title of chapter 1:

Note. Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, is similar to Telephone Test Set TS–712/TCC–11 bearing other order numbers. Information in this manual applies to all TS–712/TCC–11's unless otherwise specified.

Paragraph 1. Delete subparagraph *b* and substitute:

b. Three appendixes are included. Appendix I contains a list of references. Appendix II contains a maintenance allocation chart. Appendix III contains a basic issue item list. The complete technical manual for this equipment includes TM 11–6625–390–20P and TM 11–6625–390–35P.

Page 8, paragraph 5, line 5. Delete "One 2N21 (Q1), 1,600-cps oscillator" and substitute: One 2N1051 (transistor Q1) is used for the 1,600-cps oscillator in TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62; one WECo type No. GA–51984 (transistor Q1) is used for the 1,600-cps oscillator in TS–712/TCC–11 bearing other order numbers.

Page 23, paragraph 25*e*. Delete subparagraph *e* and substitute:

e. Use the procedures in (1) and (2) below to measure and adjust the transmission of the 68-kc pilot frequency in the AN/TCC–11.

(1) *J1–J2 direction of transmission.*

TS–712 test set SELECTOR switch position	Required meter reading (db)
AMP 1 IN 68 KC	–7 to +7
AMP 1 OUT 68 KC	–5 to +5 (See note below.)

Note: Rotate the GAIN AMP 1 switch *on the J1 end* of the AN/TCC–11 (fig. 10) to obtain a reading as close to 0 db as possible.

(2) *J2–J1 direction of transmission.*

SELECTOR switch position	Required meter reading (db)
AMP 2 IN 68 KC	–7 to +7
AMP 2 OUT 68 KC	–5 to +5 (See note below.)

Note. Rotate the GAIN AMP 2 switch *on the J2 end* of the AN/TCC–11 (fig. 7) to obtain a reading as close to 0 db as possible.

Subparagraph *f*. Delete the first sentence.

Page 25, paragraph 34*d*, fourth line from the bottom of the page. Change "chapter 6, TM 11–2148, or to a paragraph in that chapter" to: TM 11–5805–240–35.

Page 27, paragraph 36, chart. Make the following changes in the "Corrective measures" column:

Item No. 19. After "control", add: (par. 25*e*(1)).

Item No. 21. After "control", add: (par. 25*e*(2)).

Page 30, paragraph 40*a*, line 3. Change "(see TM 11–2148)" to: (see TM 11–5805–240–12).

Page 32. Paragraph 47*a*(5), line 3. Change "TM 11–2139" to: TM 11–2139–10.
Paragraph 48*a*(5), line 3. Change "TM 11–2148" to: TM 11–5805–240–12.

These Changes replace Signal Corps Repair Standard No. 1256, Issue No. 1, 19 November 1958, with Amendment No. 3, 16 August 1961, and supersede C1, 17 July 1957.

Page 34, paragraph 49. Delete the last sentence.
Paragraph 51*d*. Delete subparagraph *d*.

Page 35. Delete the heading "Section II. LUBRICATION AND WEATHERPROOFING" and insert the heading at the top of page 37.

Page 37, paragraph 54. Delete subparagraphs *b*, *c*, and *d*. Paragraph 56, line 2. Delete "and in TB SIG 23." Paragraph 57. After subparagraph *b*, add:

c. Refer to the information given in appendix II to determine the maintenance functions to be performed on the TS–712 test set by the organizational repairman, and the tools and test equipment required for organizational maintenance.

Page 39, paragraph 60*e*, chart. In the "Corrective measures" column, delete the last sentence in items No. 8, 9, and 12.

Page 49, paragraph 96. Make the following changes: In the heading, change "(fig. 8, 43)" to: (fig. 8, 43, and 43.1). Line 9. Change "(fig. 43)" to: (fig. 43 and 43.1).

Page 50, paragraph 98. Delete the last sentence and substitute: In the TS–712/TCC–11 (fig. 43.1) bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, this voltage impressed between the emitter and the collector of transistor Q1 of the 1,600-cps ringing oscillator; in the TS–712/TCC–11 bearing other order numbers (fig. 43), this voltage is impressed between the base and the collector of transistor Q1.

Delete paragraph 99 and substitute:

99. Ringing Oscillator Q1, 1,600 Cps (figs. 43 and 43.1)

Note. Transistor Q1 in TS–712/TCC–11 bearing Order No. 4488–PP–61, 4833–PP–61, 15564–PP–62, or 15766–PP–62 is an NPN junction-type transistor; in TS–712/TCC–11 bearing other order numbers, transistor Q1 is a PNP point-contact transistor. Refer to TM 11–690 for transistor fundamentals.

a. The dc voltage from the rectifier (par. 98) is applied through resistors R28 through R31 to establish the proper operating voltages for transistor Q1. Capacitors C 21 through C 24 are dc filter capacitors. Forward dc bias for the emitter-base circuit is developed across resistor R30. Reverse dc bias between base and collector is developed across resistor R27 in the TS–712/TCC–11 (fig. 43.1) bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, and across resistor R28 in the TS–712/TCC–11 (fig. 43) bearing other order numbers. The tuned circuit (1,600 cps) consists of winding 3–4–5 of transformer T2 and capacitors C 11 and C 15 (and optionally, capacitors C 12 through C 14).

b. Oscillations in the tuned circuit are applied to winding 1–2 of transformer T2. To sustain oscillations, a portion of the signal is applied to transistor Q1 through current-limiting resistor R26. In the TS–712/TCC–11 bearing order numbers than other Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, resistor R27 (fig. 43) provides feedback voltage to sustain oscillations. The 1,600-cps output signal voltage is developed across load resistors R24 and R25. When ORDER WIRE switch S5 is operated to RING, the 1,600-cps signal is applied through impedance matching resistor R23, the contacts of switch S5, transformer T3, and the contacts of OW GAIN switch S6 to terminals L and M, and N and M of connector P1.

Delete paragraphs 100 through 102 and figures 18 through 22.

Page 58, chapter 6. Make the following changes:

In paragraphs 116, 117, 121, 133, 134, 135, 141, 143, 147, 149, 151, 152, 153, and 155, and figures 27 and 37, change "Electronic Multimeter ME–6/U" and "ME–6/U" to: Voltmeter, Meter ME–30A/U or equal.

In paragraphs 116, 117, 133, 141, 143, 144, 147, 149, 151, and 152, change "Frequency Meter FR–67/U" to: Frequency Meter AN/TSM–16.

In paragraphs 116, 117, 132, 133, 134, 141, 143, 144, 148, 149, 151, 152, and 154, change "supply test-cable assembly" to: subgroup test cable assembly.

In paragraphs 116, 117, 133, 143, 147, 149, and 151, change "test cord" to: test plug assembly, and change "test jack" to: test jack assembly. Paragraph 112, chart. At the bottom of the chart, add:

Fig. No.	Par. No.	Description
43.1		Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, schematic diagram.
45		Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, wiring diagram.

Page 59, paragraph 113. Delete paragraph 113 and substitute:

113. Tools, Test Equipment, and Other Equipment Required for Troubleshooting

The tools, test equipment, and other equipment required for troubleshooting the TS–712 test set (pars. 114–117) are listed in the following chart:

Tools, test equipment, and other equipment	Technical publication	No. rqrd
Tool Equipment TE–123	SM 11–4–5180–S0–7	1
Attenuator TS–402/U or equal	TM 11–2044	1
Frequency Meter AN/TSM–16	TM 11–6625–218–12	1
Generator, Signal SG–71/FCC or equal	TM 11–5088	1
Multimeter TS–352/U or equal	TM 11–5527	1
Test Set, Electron Tube TV–7/U or equal	TM 11–6625–274–12	1
Voltmeter, Meter ME–30A/U or equal	TM 11–6625–320–12	1
Telephone EE–8–( ) or equal	TM 11–333	1
Power supply, adjustable; 135–160 vdc, 0.100 amp		1
Battery BA–23 or equal (1.5 v)		1
Test Facilities Kit MK–155/TCC; the following items of the MK–155/TCC are required:	TB SIG 328	1
Resistor, 135 ohms ±1%, 1/2 w		1
Resistor, 600 ohms, ±1%, 1/2 w		2
Resistor, 12K, ±1% 1/2 w		1
Resistor, 15K, ±5%, 1/2 w		1
Resistor, variable, 15K, 10%, 2 w		1
Matching transformer set		1
Subgroup test cable assembly		1
Test jack assembly		1
Test plug assembly		1
Test leads, 12-inch		6
Test leads, 24-inch (with alligator clips)		4

Paragraph 116*a*, last sentence. After "are connected", add: inside the TS–712 test set.

Page 61, paragraph 116. After subparagraph *b*(4), add:

(5) Attach hookup wires to the BAL. OUT binding posts of the SG–71/FCC.

Page 62, figure 27. Delete note 4 added by C 1, 17 July 1957, and substitute:

4. RESISTORS AND SUBGROUP TEST CABLE ASSEMBLY ARE PART OF THE MK–155/TCC.

Page 65, paragraph 117, chart. Make the following changes in the "Test" column for test No. 13: In the second paragraph, add the following: Operate the POWER switch to the ON position. In the third paragraph, line 12, change "and M (M is ground) of supply" to: and D (D is ground) of subgroup.

Page 66, paragraph 117, chart. Make the following changes in the "Test" column:

Test No. 17. Add the following before the last sentence: Set the TS–402/U for 0–db loss.

Test No. 19, line 13. Change "and M of supply" to: and D of subgroup.

Page 68, paragraph 117, chart. Make the following changes:

Test No. 26. In the "Test" column, delete the last sentence and substitute: The ME–30A/U should read 0.047 volt ±0.006. In the "Symptom" column, delete the sentence and substitute:

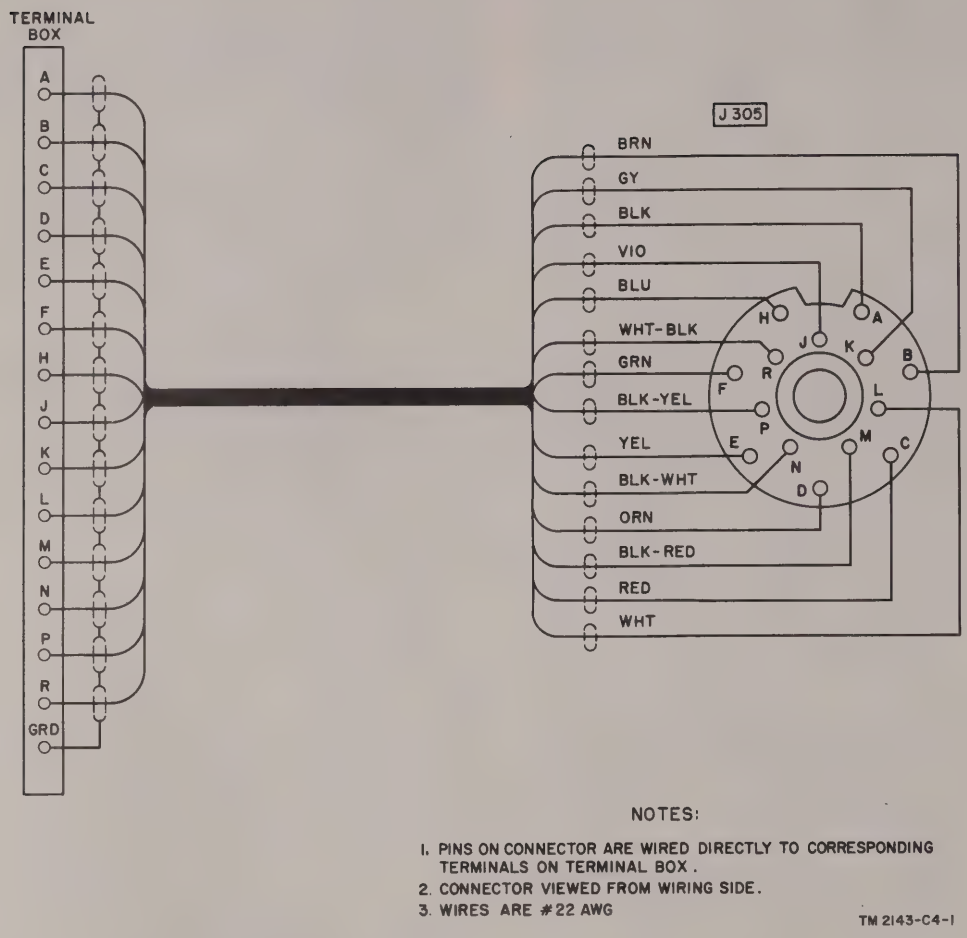


Figure 24. (Superseded) *Subgroup test cable assembly (part of MK–155/TCC).*

The ME–30A/U reads outside limits of 0.047 volt ±0.006.

Test No. 27. In the "Test" column, first sentence, change "1-volt" to: 0.3-volt; in the last sentence, change "1.7 ±1.5 db" to: 0.12 volt ±0.017. In the "Symptom" column, delete the sentence and substitute: The ME–30A/U reads outside limits of 0.12 volt ±0.017.

Test No. 28. In the "Test" column, delete the second sentence and substitute: Set the ME–30A/U to 0.3-volt range. The ME–30A/U should read 0.24 volt volt ±0.04. In the "Symptom" column, delete the sentence and substitute: The ME–30A/U reads outside limits of 0.024 volts ±0.04.

Test No. 29. In the "Test" column, delete the last sentence and substitute: Set

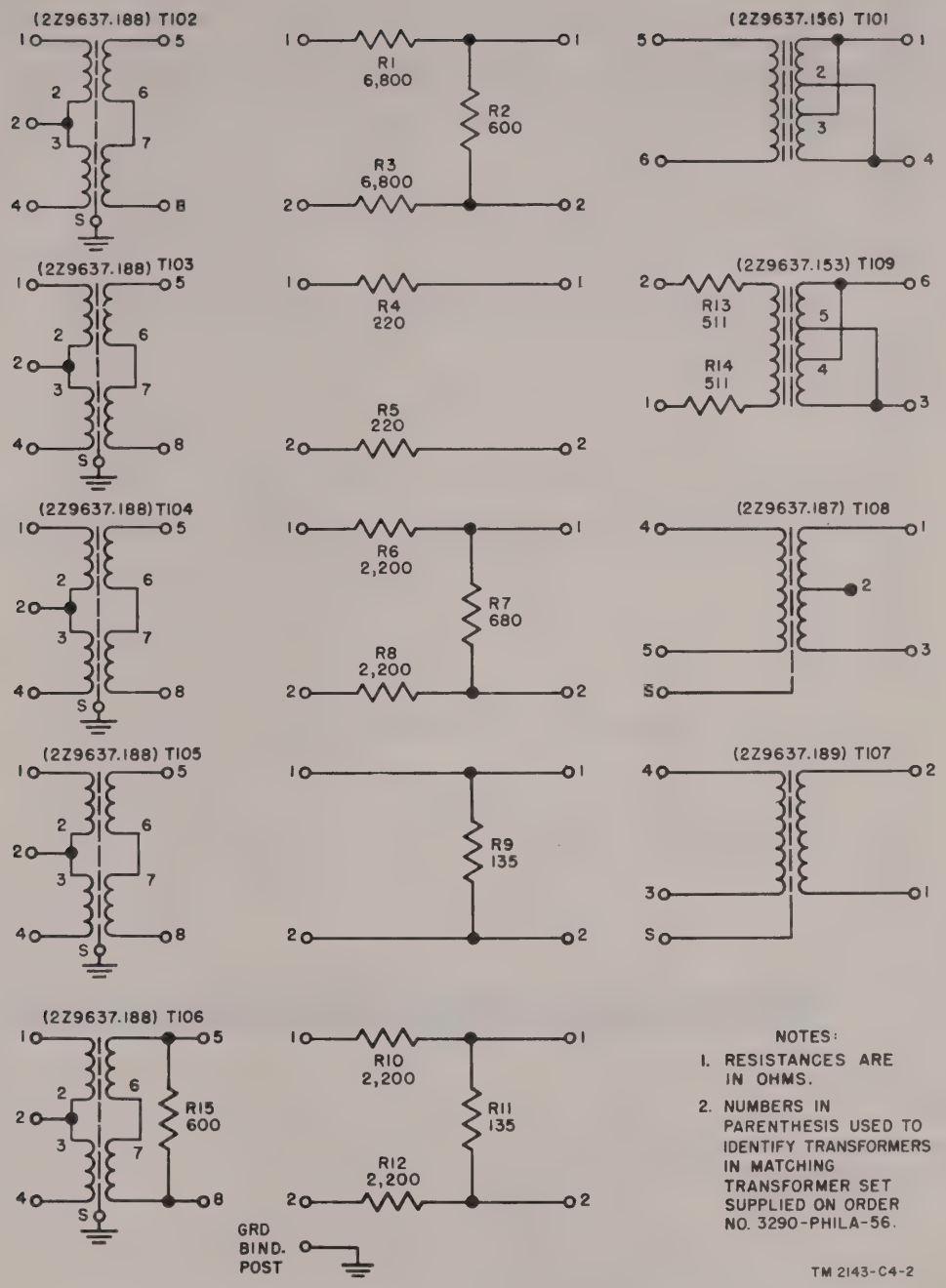


Figure 24.1. (Superseded) *Matching transformer set (part of MK–155/TCC).*

the ME–30A/U to the 0.3-volt range. The ME–30A/U should read 0.13 volt ±0.015. In the "Symptom" column, delete the sentence and substitute: The ME–30A/U reads outside limits of 0.13 volt ±0.015.

Test No. 30. In the "Test" column, delete the last sentence and substitute: The ME–30A/U should read 0.032 volt ±0.005. In the "Symptom" column, delete the sentence and substitute: The ME–30A/U reads outside limits of 0.032 volt ±0.005.

Test No. 31. In the "Test" column, delete the second sentence and substitute: Set the ME–30A/U to the 0.03-volt

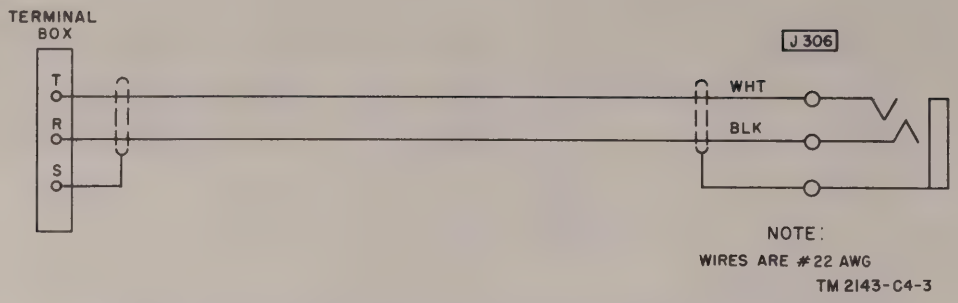


Figure 24.2. (Superseded) *Test jack assembly (part of MK–155/TCC).*

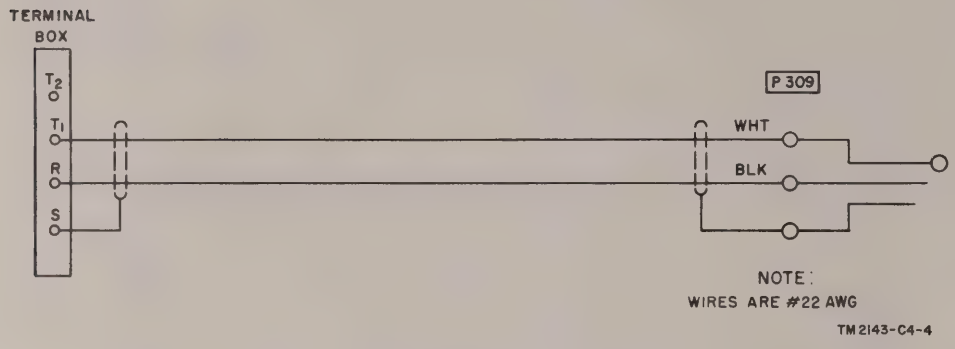
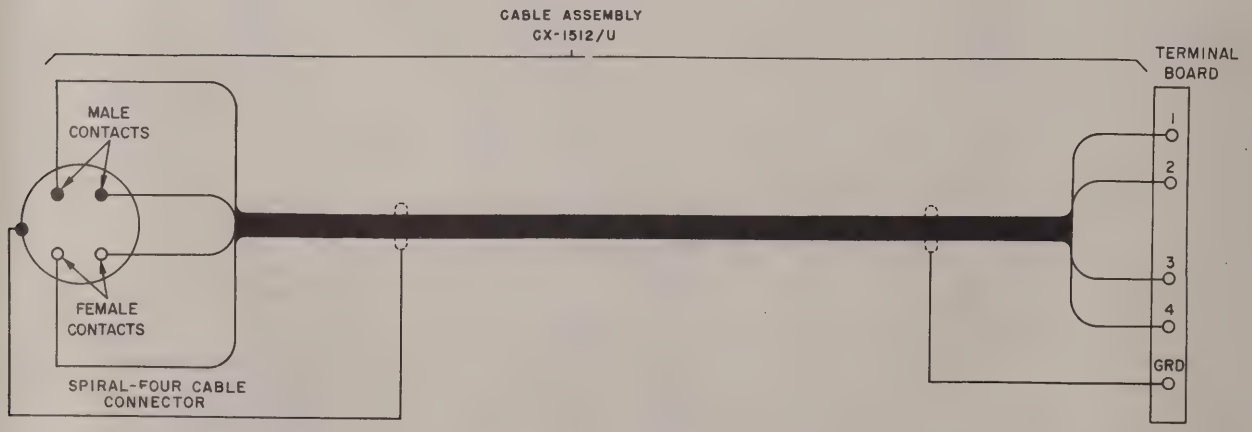


Figure 24.3. (Superseded) *Test plug assembly, (part of MK–155/TCC).*



NOTES:

1. MALE CONTACTS ON THE CONNECTOR ARE WIRED TO TERMINALS 1 AND 2 OF THE TERMINAL BOARD.
2. FEMALE CONTACTS ON THE CONNECTOR ARE WIRED TO TERMINALS 3 AND 4 OF THE TERMINAL BOARD.

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Figure 25. (Superseded) *Junction panel test cable assembly (part of MK–155/TCC), used to test artificial cable Z1.*

Figure 26. (Superseded) *Test setup for trouble-shooting, signal substitution tests, and final test procedures.*

(Located in back of manual)

range. The ME–30A/U should read 0.012 volt ±0.002. In the "Symptom" column, delete the sentence and substitute: The ME–30A/U reads outside limits of 0.012 volt ±0.002.

Page 79. Make the following changes:

Paragraph 119. Delete paragraph 119 changed by C 1, 17 July 1957, and substitute:

119. Test Equipment and Other Equipment Required for Additional Troubleshooting

The following chart lists the test equipment and other equipment required for additional troubleshooting tests given in paragraphs 120 through 130.

Test equipment and other equipment	Technical publication	No. reqd
Analyzer ZM–3/U or equal	TM 11–5043–12	1
Generator, Signal SG–71/FCC or equal	TM 11–5088	1
Voltmeter, Meter ME–30A/U or equal	TM 11–6625–320–12	1
Multimeter TS–352/U or equal	TM 11–5527	1
Meter Test Set TS–682A/GSM–1 or equal	TM 11–2535B	1
Test Facilities Kit MK–155/TCC; the following items of the MK–155/TCC are required:	TB SIG 328	1
Resistor, 135 ohms, ±1%, 1/2 w		1
Resistor, 365 ohms, ±1%, 1/2 w[a]		1
Resistor, 600 ohms, ±1%, 1/2 w		1
Resistor, 470 ohms, ±1%, 1/2 w[a]		2
Resistor, 1,200 ohms, ±1%, 1/2 w[a]		1
Resistor, 1,800 ohms, ±1%, 1/2 w[a]		1
Resistor, 2,200 ohms, ±1%, 1/2 w[b]		1
Resistor, 153K, ±1%, 1/2 w[a]		1
Resistor, 227K, ±1%, 1/2 W[a]		1
Junction panel test cable assembly		1
Subgroup test cable assembly		1
Matching transformer set		1
Test leads, 12-inch		8
Test leads, 24-inch (with alligator clips)		4

[a]Composited from resistors in MK–155/TCC.
[b]Part of matching transformer set in MK–155/TCC.

Paragraph 120. Make the following changes:

In the heading and in lines 3 and 7, change "artificial cable Z1" to: cable simulating network (Z1)Z1. After the last sentence, add: If the cable simulating network (Z1)Z1 is defective, replace artificial cable Z1.

Paragraph 121. Make the following changes:

In the heading, in the introduction, line 2, and in subparagraph *a*, line 4, change "artificial cable Z1" to: cable simulating network (Z1)Z1.

Subparagraph *a*(4). Delete and substitute:

(4) Adjust the SG–71/FCC output control for a reading of 0.3 volt ac on the ME–30A/U (A, fig. 37) for each test frequency given in the chart in *b*(4) below.

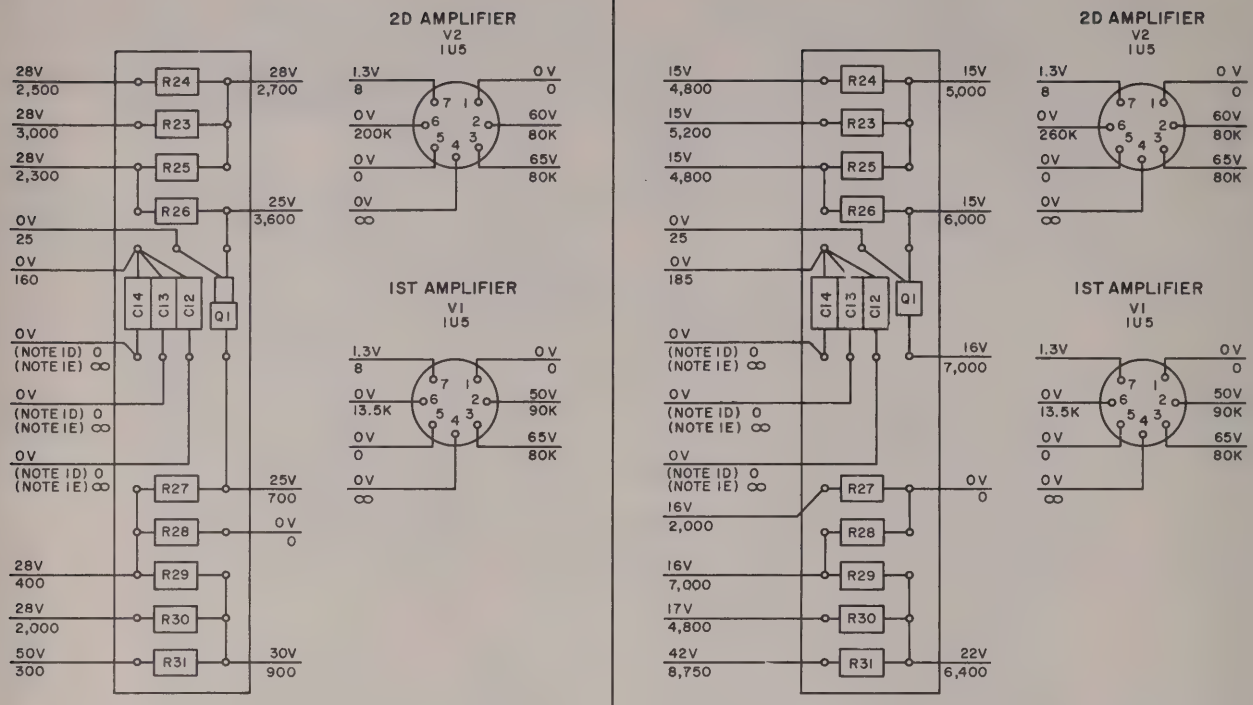
Page 80, paragraph 121*b*. Delete subparagraph *b* changed by C 1, 17 July 1957, and substitute:

b. Follow the procedures given in (1) through (4) below after the pretest procedures in *a* above have been performed.

(1) Insert the filter or cable simulating network (Z1)Z1 into the circuit as shown in B, figure 37.

(2) The ME–30A/U indication for the output level should be the same as given in the last column of the chart in (4) below.

(3) Repeat the test procedures given in *a* above and in (1) and (2) above for



A. TS-712/TCC-11 (EXCEPT THOSE BEARING ORDERS NO. 4488-PP-61, 4933-PP-61, 15564-PP-62, OR 15766-PP-62)

B. TS-712/TCC-11 (BEARING ORDERS NO. 4488-PP-61, 4933-PP-61, 15564-PP-62, OR 15766-PP-62)

NOTES:

1. CONDITIONS FOR VOLTAGE AND RESISTANCE MEASUREMENTS ON RESISTOR-CAPACITOR BOARD:
   - A. OPERATE THE [ORDER WIRE] SWITCH TO [RING]
   - B. FOR RESISTANCE MEASUREMENTS: ON PART A OF THE DIAGRAM, CONNECT THE COMMON LEAD (–) OF THE OHMMETER TO TERMINAL 3 OF TRANSFORMER T2; ON PART B OF THE DIAGRAM, CONNECT THE OTHER LEAD (+) OF THE OHMMETER TO TERMINAL 3 OF TRANSFORMER T2.
   - C. FOR VOLTAGE MEASUREMENTS: CONNECT A FIELD TELEPHONE (SUCH AS TELEPHONE EE-8-( )) TO THE [TEL] BINDING POSTS AND OPERATE THE TELEPHONE HAND GENERATOR AT NORMAL SPEED (APPROXIMATELY 80 VOLTS AC ±10); CONNECT THE COMMON LEAD OF THE DC VOLTMETER TO TERMINAL 3 OF TRANSFORMER T2.
   - D. RESISTANCE INDICATION OBTAINED WHEN THE CAPACITOR IS CONNECTED TO RESISTOR R28.
   - E. RESISTANCE INDICATION OBTAINED WHEN THE CAPACITOR IS NOT CONNECTED TO RESISTOR R28.
2. CONDITIONS FOR VOLTAGE AND RESISTANCE MEASUREMENTS AT TUBE SOCKETS:
   - A. CONNECT THE COMMON LEAD (–) OF THE TEST METER TO THE CHASSIS OF THE TS-712 TEST SET.
   - B. OPERATE THE [SELECTOR] SWITCH TO [AMP I IN IKC]
   - C. FOR VOLTAGE MEASUREMENTS: OPERATE THE [POWER] SWITCH TO [ON] AND ADJUST THE OUTPUT OF EACH INTERNAL BATTERY IN THE TS-712 TEST SET TO OBTAIN [BAT.] INDICATION ON TS-712 TEST SET METER.
   - D. FOR RESISTANCE MEASUREMENTS: OPERATE THE [POWER] SWITCH TO [OFF].
3. VOLTAGE INDICATIONS ARE SHOWN ABOVE THE LINE AND RESISTANCE INDICATIONS ARE SHOWN BELOW THE LINE.
4. ALL VOLTAGE INDICATIONS ARE DC AND TAKEN WITH A 20,000-OHMS-PER-VOLT METER.
5. [ ] INDICATES EQUIPMENT MARKING.

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Figure 31. (Superseded) *Telephone Test Set TS–712/TCC–11, voltage and resistance diagrams.*

each frequency listed in the chart for the filter or cable simulating network (Z1)Z1 being tested.

(4) Use the following chart in conjunction with the requirements in *a* and (1), (2), and (3) above.

Filter or cable simulating network (Z1)Z1	Resistors (ohms) (fig. 37)[a]		Test frequency of SG–71/FCC	Output signal level (volt) on ME–30A/U (B, fig. 37)
	A	B		
Filter FL1	0	227K	55 kc	0.01 max
			68 kc	0.25 min
			75 kc	0.1 max
Filter FL2	0	153K	10 cps	0.0056 max
			500 cps	0.032 max
			1,500 cps	0.25 min
Cable simulating network (Z1)Z1	1,200	1,800	10 kc	0.008 max
			12 kc	0.06 min
			68 kc	0.02 min

[a]Resistors are part of MK–155/TCC (para 119).

Figure 37. Make the following changes:

In the caption, change, *"artificial cable Z1"* to: *cable simulation network (Z1)Z1.*

Add the following to the notes:

3. RESISTORS ARE PART OF MK–155/TCC.

Page 81, paragraph 128, introduction. Make the following changes:

In line 2, change "Test Equipment Meter AN/GSM–1" to: Meter Test Set TS–682A/GSM–1. Change the second sentence to: Instructions for the use of the TS–682A/GSM–1 are in TM 11–2535B.

Page 82, paragraph 128*b* through *d.* Make the following changes:

Change "Test Equipment Meter AN/GSM–1" and "AN/GSM–1" to: Meter Test Set TS–682A/GSM–1.

Page 83, paragraph 133*d.* After the first sentence, add: Rotate the GAIN control (internal) on the TS–712 test set fully clockwise.

Paragraph 134*a,* last sentence. After "normal speed" add: (equivalent to 90 volts ac ± 5 at 18 cps ±2).

Page 84, paragraph 134*d.* Make the following changes:

Delete the second sentence and substitute: When testing the TS–712/TCC–11, except those bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, connect the *common* test lead (–DC ±AC OHMS) of the TS–352/U to standoff terminal E10 (fig. 43); when testing the TS–712/TCC–11, bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, connect the other test lead (+) of the TS–352/U to standoff terminal E10 (fig. 43.1).

Delete the chart and substitute:

Measuring point	Typical indication (volts dc)		Corrective measures
	TS–712/TCC–11 (except those bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62)	TS–712/TCC–11 (bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62)	
Standoff terminal E4	42	50	If incorrect indications are obtained, check the 1,600–cps oscillator circuit components: varistors (par. 126), capacitors (par. 123), resistors (par. 122*a*), transformer T2 (par. 125), and transistor Q1 (par. 129).
Junction of R29 and C24	16	28	
Terminal 1 of T2	15	28	
At the junction of R27 and Q1	25		
At the junction of R29 and Q1		28	

Paragraph 135. Make the following changes:

Subparagraph *a*(2), line 2. Change "18 db" to: 0.775 volt ac. Subparagraph *c*, line 2. Change "transmission" to: junction panel.

Subparagraph *d*. In line 8, after "(Z1) T1", add: (par. 125); in line 9, after "(Z1)(Z1", add: (par. 121). Subparagraph *e*, line 6. After "(Z1)T2", add, (par. 125); after "(Z1)Z1", add: (par. 121).

Subparagraph *f*, Change subparagraph *f* to:

f. Connect the ME–30A/U as shown in figure 38. The ME–30A/U should read 0.135 volt ±0.02 on the 0.3-volt range. If trouble is indicated, check transformer (Z1)T2 (par. 125).

Page 85. paragraph 135*k*, line 2. Change "15.1 ±1.5 db on the 1-volt range" to: 0.054 volt ± 0.01 on the 0.1-volt range.

Page 86, paragraph 137. Delete the second sentence.

Paragraph 140. Delete paragraph 140 changed by C 1, July 1957, and substitute:

140. Test Equipment and Other Equipment Required for Alignment

The following test equipment and other equipment are required for the alignment procedure given in paragraphs 141 through 144.

Test equipment and other equipment	Technical publication	No. reqd
Attenuator TS–402/U or equal	TM 11–2044	1
Frequency Meter AN/TSM–16 or equal	TM 11–6625–218–12	1
Generator, Signal SG–71/TCC or equal	TM 11–5088	1
Voltmeter, Meter ME–30A/U or equal	TM 11–6625–320–12	1
Telephone EE–8–( ) or equal	TM 11–333	1
Test Facilities Kit MK–155/TCC; the following items of the MK–155/TCC are required:	TB SIG 328	1
Resistor, 135 ohms, ±1%, 1/2 w		1
Resistor, 600 ohms, ±1%, 1/2 w		2
Matching transformer set		1
Subgroup test cable assembly		1
Test Jack assembly		1
Test plug assembly		1
Test leads, 12-in.		8
Test leads, 24-in. (with alligator clips)		2

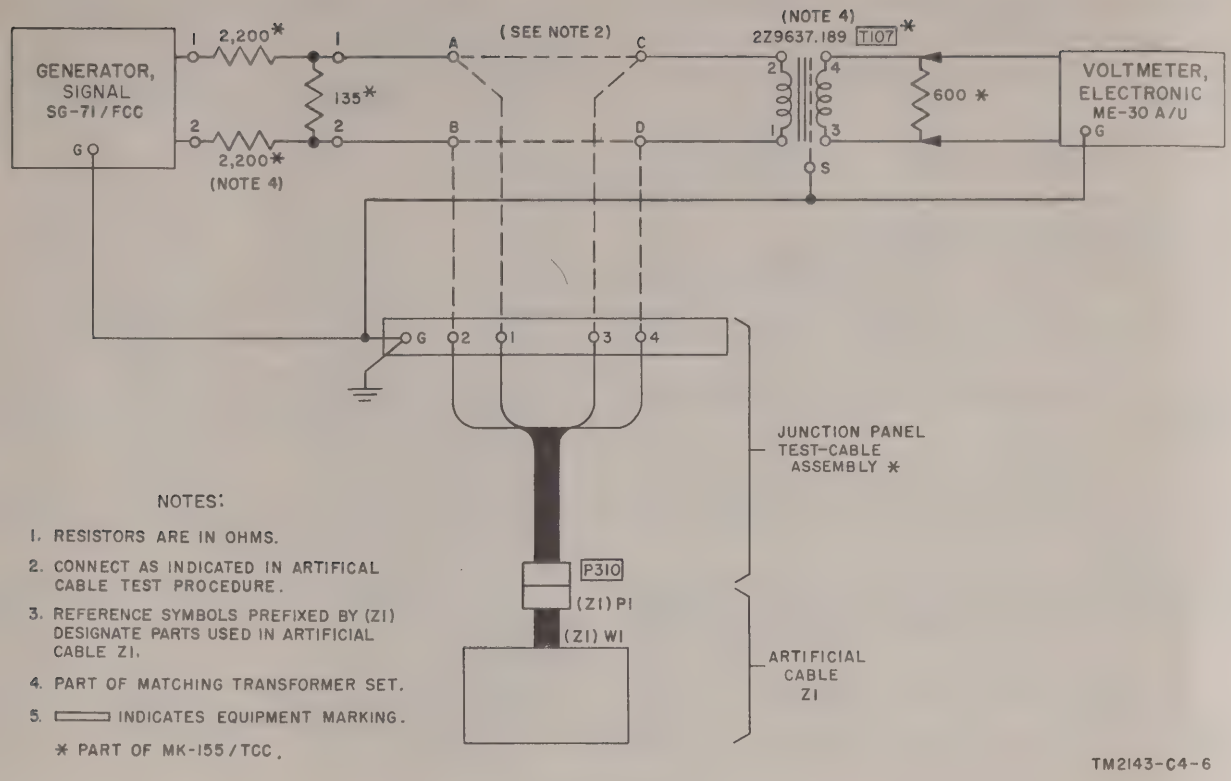

Figure 38. (Superseded) *Artificial cable Z1 test setup.*

Page 87, paragraph 143. Make the following changes:

Subparagraph *a*. After "68 KC position," add: operate the ORDER WIRE switch to TALK position.

Subparagraph *c*, line 2. Change "M" to: D. Paragraph 144*b*, line 2. After "(200 rpm)" add: equivalent to 90 volts ac ±5 at 18 cps ±2.

Page 88. Change the title of section IV to: DEPOT INSPECTION STANDARDS.

Delete paragraph 145 and substitute:

145. Applicability of Depot Inspection Standards and References

a. General. The tests outlined in this section are designed to measure the performance capability of a repaired equipment. Equipment that meets the standards stated in the tests will have performance capabilities to that of new equipment. Applicable references are given below:

b. References.

(1) *Repair Standards.* Applicable paragraphs of TB SIG 355–1, General Standards for Repaired Signal Equipment, form a part of the requirements for testing this equipment.

(2) *Modification Work Orders.* Perform all applicable Modification Work Orders (MWO's) pertaining to this equipment before making the tests specified. DA Pam 310–4 lists all current MWO's. Paragraph 146. Delete paragraph 146 changed by C 1, 17 July 1957 and substitute:

146. Tools, Test Equipment, and Other Equipment Required

The tools, test equipment, and other equipment required for the tests outlined in paragraphs 147 through 155 are the same as those listed in paragraph 113, except that TV–7/U is not required.

Page 89, paragraph 148*h*, line 4. Change "V AMP 2" to: V2 AMP 2.

Page 90, paragraph 149. Make the following changes:

Subparagraph *a*, line 1. Change "para-2" to: paragraph 142.

Subparagraph *b*. In lines 1 and 9, change "figure 26" to: A, figure 26.

Subparagraph *c*. In line 2, change "M" to: D.

Paragraph 151*a*(2), line 6. Change "M" to: D.

Page 91, paragraph 151*c*. Make the following changes:

Line 3. Change "M" to: D.

Line 13. Change "10 db" to: 0.30 volt.

Line 18. Change "10 ±1 db" to: 0.03 volt ±0.005.

Paragraph 152*a*, line 8. After "(200 rpm)", add: equivalent to 90 volts ac ±5 at 18 cps ±2.

Paragraph 153*a*, line 8. Change "14 db" to: 0.5 volt.

Page 92, paragraph 153*b* chart. Delete the chart and substitute:

OW GAIN switch position	ME–30A/U connection to subgroup test cable assembly (terminals)	ME–30A/U meter indication (volt ac)
LOW	L and M	0.0475 ±0.0075
MED	L and M	0.120 ±0.02
HIGH	L and M	0.240 ±0.04
LOW	N and M	0.012 ±0.0075
MED	N and M	0.032 ±0.0075
HIGH	N and M	0.130 ±0.02

Paragraph 155. Make the following changes:

Subparagraph *a*, line 6. Change "18 db" to: 0.775 volt.

Subparagraph *b*, line 2. Change "transmission" to: junction panel.

Line 6, change "2.4 ±1.5 db on the 1-volt range" to: 0.135 volt ±0.02 on the 0.3-volt range.

Subparagraph *c*, line 4. Change "15.1 "1.5 db" to: 0.056 volt ±0.005.

APPENDIX (SUPERSEDED)
REFERENCES

DA PAM 310–4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Orders.
SM 11–4–5180–S07	Stocklist of Components, Sets, Kits, and Outfits.
TB SIG 328	Telephone Carrier System Test Facilities Kit MK–155/TCC.
TM 11–333	Telephones EE–8, EE–8–A, and EE–8–B.
TM 11–690	Basic Theory and Application of Transistors.
TM 11–2044	Attenuators TS–402/U and TS–402A/U.
TM 11–2139–10	Operator's Manual: Telephone Terminals AN/TCC–7.
TM 11–2140–10	Telephone Repeater AN/TCC–8 and Telephone Repeater AN/TCC–21; Operator's Manual.
TM 11–2150	Telephone Carrier Systems Using Telephone Terminals AN/TCC–7 and Telephone Repeater, AN/TCC–8 (AN/TCC–21), Telephone Repeater, AN/TCC–11, and Telephone Test Set TS–712/TCC–11.
TM 11–2155	Telephone Set TA–312/PT.
TM 11–2535B	Meter Test Set TS–682A/GSM–1.
TM 11–5043–12	Analyzers ZM–3/U and ZM–3A/U: Operator's and Organizational Maintenance Manual.
TM 11–5088	Generators, Signal SG–71/TCC, SG–71A/FCC, and SG–71B/FCC.
TM 11–5527	Multimeters TS–352/U, TS–352A/U and TS–352B/U.
TM 11–5805–200–12P	Operator's and Organizational Maintenance Repair Parts and Special Tools List and Maintenance Allocation chart for Telephone EE–8, –8A, –8B, –8C, –8D, and –8E.
TM 11–5805–240–12	Operator's and Organizational Maintenance Manual: Repeater, Telephone AN/TCC–11.
TM 11–5805–240–35	Field and Depot Maintenance Manual: Repeater, Telephone AN/TCC–11.
TM 11–5805–256–12P	Operator's Organizational Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart for Telephone Set TA–43/PT.
TM 11–5805–257–12P	Operator and Organizational Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart: Generators, Ringing, Hand G–42/PT, and G–42A/PT.
TM 11–5805–272–12P	Operator's and Organizational Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart for Generators GN–38, –38A, and –38B.
TM 11–5965–216–15P	Operator, Organizational, Field, and Depot Maintenance Repair Parts and Special Tools Lists and Maintenance Allocation Chart: Handset TS–9–F.
TM 11–5965–224–15P	Operator, Organizational, Field, and Depot Maintenance Repair Parts and Special Tools Lists and Maintenance Allocation Chart: Handset H–60/PT and H–165/U.
TM 11–6625–218–12	Operation and Organizational Maintenance: Frequency Meter AN/TSM–16.
TM 11–6625–274–12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV–7/U, TV–7A/U, TV–7B/U, and TV–7D/U.

TM 11–6625–320–12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter, ME–30A/U and Voltmeters, Electronic ME–30B/U and ME–30C/U.
TM 11–6625–390–20P	Organizational Maintenance Repair Parts and Special Tool Lists: Telephone Test Set TS–712/TCC–11.
TM 11–6625–390–35P	Field and Depot Maintenance Repair Parts and Special Tools Lists: Telephone Test Set TS–712/TCC–11.
TM 38–750	The Army Equipment Record System and Procedures.

Figure 43 (foldout). Add the following to the notes:

9. REFER TO FIGURE 43.1 FOR THE SCHEMATIC DIAGRAM OF THE TS–712/TCC–11 BEARING ORDER NO. 4488–PP–61, 4933–PP–61, 15564–PP–62, OR 15766–PP–62.

Figure 44 (foldout). Add the following to the notes:

16. REFER TO FIGURE 45 FOR THE WIRING DIAGRAM OF THE TS–712/TCC–11 BEARING ORDER NO. 4488–PP–61, 4933–PP–61, 15564–PP–62, OR 15766–PP–62.

Figure 43.1. (Added) *Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, schematic diagram.*
(Located in back of manual)

Figure 45. (Added) *Telephone Test Set TS–712/TCC–11 bearing Order No. 4488–PP–61, 4933–PP–61, 15564–PP–62, or 15766–PP–62, wiring diagram.*
(Located in back of manual)

BY ORDER OF THE SECRETARY OF THE ARMY:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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Br Svc Sch (2)
GENDEP (2) except
Atlanta GENDEP (none)
Sig Sec, GENDEP (5)
Sig Dep (12) except
Sacramento Sig Dep (17)
WRAMC (1)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
USAEPG (2)
AFIP (1)
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EMC (1)
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Sig Fld Maint Shops (3)
Def Log Svc Cen (1)
USA Corps (3)
JBUSMC (2)
Hq, AMC (5)
Units organized under fol TOE:
(2 copies UNOINDC)
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11–47
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11–57
11–85
11–86
11–87
11–97
11–98
11–117
11–155
11–500 (AA–AE) (4)
11–557
11–587
11–592
11–597
17
37

NG: State AG (3); Units—same as active army except allowance is one copy to ea unit.
USAR: None.
For explanation of abbreviations used see AR 320–50.

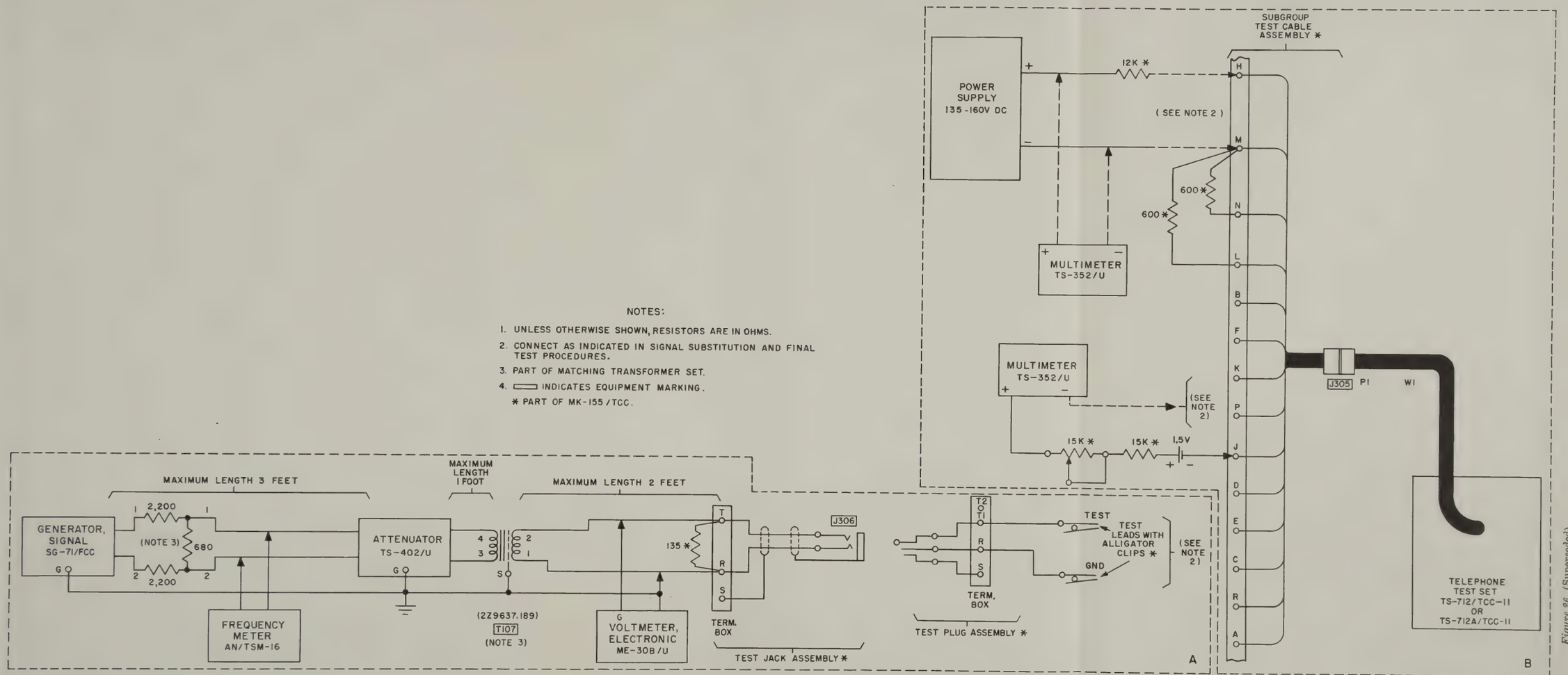


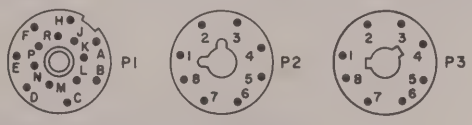
Figure 26. (Superseded) *Test setup for troubleshooting, signal substitution tests, and final test procedures.*

TM2143-C4-5

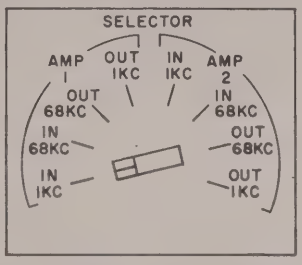
Figure 26. (Superseded)

NOTES:

1. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. CONNECTORS P1, P2 AND P3 ARE VIEWED FROM PIN SIDE.



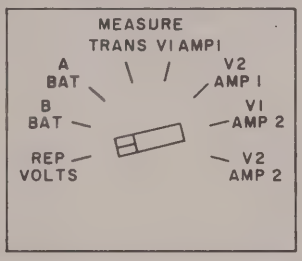
3. SWITCH S1 VIEWED FROM KNOB SIDE.



S1 SELECTOR SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
IN IKC AMP 1	1-12	12-1	1-11	10-11
IN 68KC AMP1	2-12	12-2	2-11	10-11
OUT 68KC AMP1	3-12	12-3	3-11	4-11
OUT IKC AMP 1	4-12	12-4	4-11	—
IN IKC AMP 2	5-12	12-5	—	6-4
IN 68KC AMP 2	6-12	12-6	—	7-4
OUT 68KC AMP2	7-12	12-7	7-5	8-4
OUT IKC AMP 2	8-12	12-8	—	9-4

4. SWITCH S3 VIEWED FROM KNOB SIDE.

TO AN/TCC-11, TEST CONNECTOR J3



S3 MEASURE SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
REP VOLTS	10-9	9-10	4-3	3-4
B BAT	11-9	9-11	5-3	3-5
A BAT	12-9	9-12	6-3	3-6
TRANS	1-9	9-1	3-7	7-3
V1 AMP 1	2-9	9-2	8-3	3-8
V2 AMP 1	3-9	9-3	9-3	3-9
V1 AMP2	4-9	9-4	10-3	3-10
V2 AMP2	5-9	9-5	11-3	3-11

5. SWITCH S6 VIEWED FROM KNOB SIDE.

S6 OW GAIN SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2A	SECTION 2B	SECTION 3
LOW	2-3	3-2	8-9	9-8
MED	2-4	4-2	8-10	10-8
HIGH	2-5	5-2	8-11	11-8

6. METER M1 IS A MICROAMMETER CALIBRATED IN DECIBELS.
7. STRAP AS REQUIRED TO OBTAIN PROPER FREQUENCY UPON REPLACEMENT OF ASSOCIATED PARTS.
8. THE TURNS RATIOS OF THE WINDINGS OF TRANSFORMER T2 ARE AS FOLLOWS: 29.4 (WINDING 3-5): 4.2 (WINDING 3-4): 1 (WINDING 1-2).

Figure 48.1 (Added)

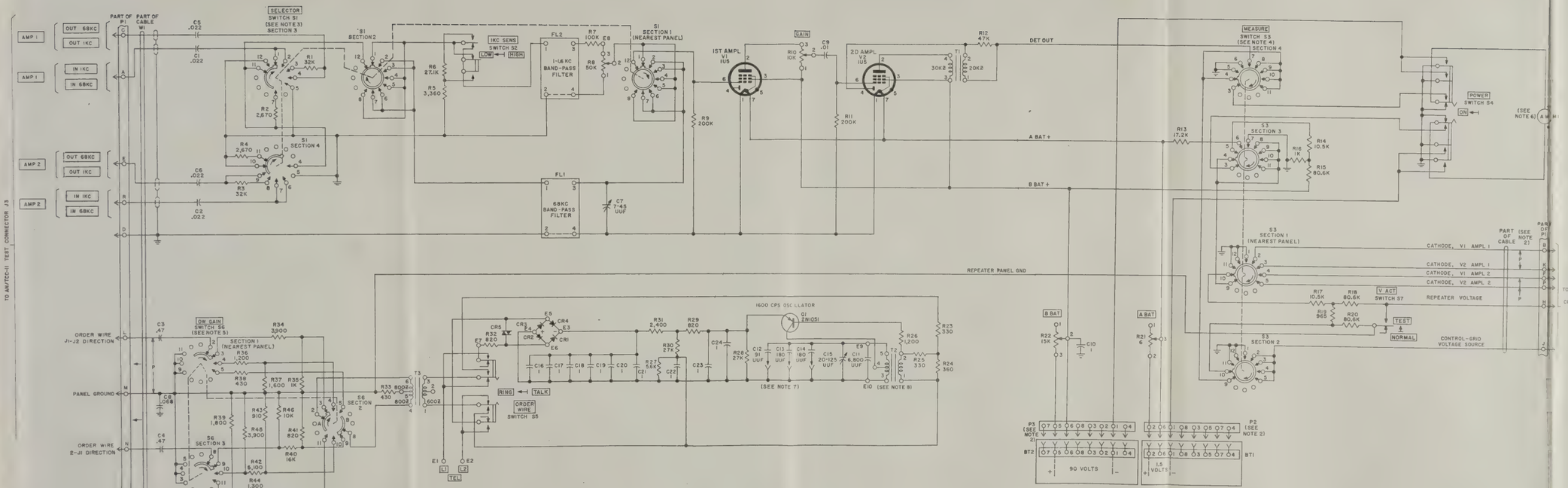
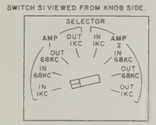


Figure 43.1 (Added) *Telephone Test Set TS-712/TCC-11 bearing Order No. 4488-PP-61, 4933-PP-61, 15564-PP-62, or 15766-PP-62, schematic diagram.*

NOTES

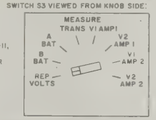
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. CONNECTORS P1, P2 AND P3 ARE VIEWED FROM PIN SIDE

3. SWITCH S1 VIEWED FROM KNOB SIDE.



S1 SELECTOR SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
IN 1KC AMP 1	1-12	12-1	1-11	10-11
IN 68KC AMP 1	2-12	12-2	2-11	10-11
OUT 68KC AMP 1	3-12	12-3	3-11	4-11
OUT 1KC AMP 1	4-12	12-4	4-11	—
IN 1KC AMP 2	5-12	12-5	—	6-4
IN 68KC AMP 2	6-12	12-6	—	7-4
OUT 68KC AMP 2	7-12	12-7	7-5	8-4
OUT 1KC AMP 2	8-12	12-8	—	9-4

4. SWITCH S3 VIEWED FROM KNOB SIDE:



S3 MEASURE SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2	SECTION 3	SECTION 4
REP VOLTS	10-9	9-10	4-3	3-4
B BAT	11-9	9-11	5-3	3-5
A BAT	12-9	9-12	6-3	3-6
TRANS	1-9	9-1	3-7	7-3
V1 AMP 1	2-9	9-2	8-3	3-8
V2 AMP 1	3-9	9-3	9-3	3-9
V1 AMP 2	4-9	9-4	10-3	3-10
V2 AMP 2	5-9	9-5	11-3	3-11

5. SWITCH S6 VIEWED FROM KNOB SIDE

S6 OW GAIN SWITCH TABLE OF CONTACTS MADE				
SWITCH POSITION	SECTION 1	SECTION 2A	SECTION 2B	SECTION 3
LOW	2-3	3-2	8-9	9-8
MED	2-4	4-2	8-10	10-8
HIGH	2-5	5-2	8-11	11-8

6. METER M1 IS A MICROAMMETER CALIBRATED IN DECIBELS.
7. STRAP AS REQUIRED TO OBTAIN PROPER FREQUENCY UPON REPLACEMENT OF ASSOCIATED PARTS
8. THE TURNS RATIOS OF THE WINDINGS OF TRANSFORMER T2 ARE AS FOLLOWS: 29.4 (WINDING 3-5); 4.2 (WINDING 3-4); 1 (WINDING 1-2).

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Figure 43.1 (Added)

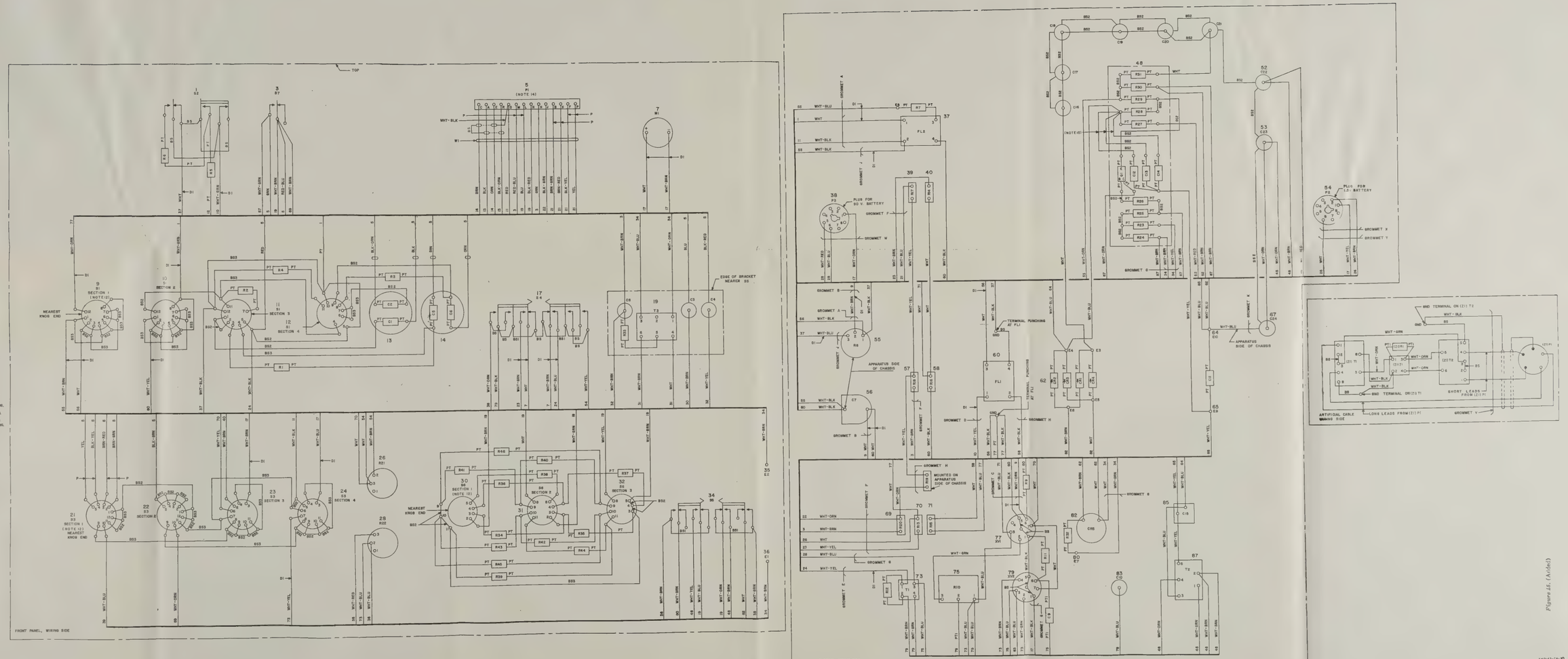
NOTES:
1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAGE WITH NYLON JACKET.
3. DI WIRING IS CONNECTED DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER
4. BS DENOTES 22 GAGE TINNED, ANNEALED COPPER WIRING.
5. BSI DENOTES 22 GAGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBREGLAS SLEEVING.
6. BS2 DENOTES 20 GAGE TINNED, ANNEALED COPPER WIRING.
7. BS3 DENOTES 20 GAGE TINNED, ANNEALED COPPER WIRING COVERED WITH SILICON IMPREGNATED FIBREGLAS SLEEVING.
8. PT DENOTES LEADS PART OF APPARATUS.
9. P DENOTES PAIR.
10. DENOTES SHIELDED CONNECTION.
11. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER.
12. TERMINALS INSIDE OF CIRCLE ARE ON SIDE OF D184 FARTHEST FROM KNOB END AND TERMINALS ON OUTSIDE OF CIRCLE ARE ON SIDE OF D184 NEAREST TO KNOB END.
13. DI WIRING RUNNING THROUGH GROMMETS A,B,C,D, AND E HAS ENOUGH SLACK TO PERMIT THE CHASSIS TO HINGE.
14. CONNECTOR P1 IS A CIRCULAR CONNECTOR. PHYSICAL P1N LOCATION IS SHOWN ON SCHEMATIC DIAGRAM OF THE TELEPHONE TEST SET TS-718/TCC-11 CIRCUIT.
15. CAPACITORS C12, C13, AND C14 ARE STRAPPED SO THAT THE 1600 CYCLE TRANSFORMER T3 MAY BE PROPERLY TUNED.
TOP
FRONT PANEL, WIRING SIDE
CHASSIS, WIRING SIDE
NEAREST KNOB END
EDGE OF BRACKET NEARER S8
PLUG FOR 90 V. BATTERY
PLUG FOR 1.5 BATTERY
TERMINAL PUNCHING AT FL1
APPARATUS SIDE OF CHASSIS
MOUNTED ON APPARATUS SIDE OF CHASSIS
GND TERMINAL ON (21) T2
GND TERMINAL ON (21) P1
SHORT LEADS FROM (21) P1
LONG LEADS FROM (21) P1
ARTIFICIAL CABLE WIRING SIDE
GROMMET A
GROMMET B
GROMMET C
GROMMET D
GROMMET E
GROMMET F
GROMMET G
GROMMET H
GROMMET W
GROMMET X
GROMMET Y
GROMMET Z
TM3143-C4-10

Figure 15. (Added) *Telephone Test Set TS-718/TCC-11 bearing Order No. 4488-PP-61, 4953-PP-61, 15564-PP-62, or 15766-PP-62, wiring diagram.*

Figure 15. (Added)